

Waianakarua River morphology and riparian management strategy

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Overview

The Waianakarua River morphology and riparian management strategy has been prepared by the Otago Regional Council (ORC), with input from the local community, to help protect the recreational, cultural and ecological values of the Waianakarua riverbed, and to enable long-term sustainable use of the land that borders the river. The strategy, as summarised in the two diagrams overleaf, is intended to help achieve this by guiding work programs, decision-making, and activities for the community, stakeholders, iwi and ORC. It is therefore recommended that people who live, work, or play within the Waianakarua River catchment consider, and give effect to, the principles, objectives, and actions listed in this strategy.

The strategy is not a statutory document; rather it is intended to present the aspirations of the community, iwi and the various stakeholder agencies. However, the statutory processes that do influence river management activities¹ are more likely to be used effectively and efficiently if there is a general consensus on what is valued about the river, and commonly understood objectives.

The strategy is intended to be a living document, which will evolve in response to new information, changes in the environment, the needs of the community and iwi, and the work of the ORC and other stakeholders. The strategy will be reviewed regularly, and this process will involve landowners with property alongside the river, other stakeholders, and ORC² working in partnership with iwi and will help to set priorities and work programmes for all of these groups. The strategy document will also record progress made towards achieving the stated objectives. It is intended that version 2 of the strategy will include further guidance and plans for undertaking planting on riparian margins, for river management purposes, and for habitat enhancement.

¹ Including the Local Government Act (in regards to funding considerations), and the Resource Management Act (in regards to environmental effects)

² In particular, staff with responsibilities for river and waterway management and natural hazards

Mana Whenua

Mana Whenua literally means ‘the people with mana over the land’ and refers to the whānau (families), hapū (sub-tribe) or iwi (tribe) of a particular area who are recognised as holding the traditional rights and responsibilities within that area to manage and govern natural resources.

Ngāi Tahu³ is the iwi that is Mana Whenua in Otago. Te Rūnanga o Ngāi Tahu (the iwi authority) is made up of 18 Papatipu Rūnaka. Located predominantly in traditional coastal settlements, Papatipu Rūnaka are a focus for whānau and hapū who have Mana Whenua status within their area. Te Rūnanga o Moeraki and Kāti Huirapa Rūnaka ki Puketeraki are the two Papatipu Rūnaka of Ngāi Tahu who are Mana Whenua of the Waihemo catchment.

Kāi Tahu – Treaty Partner

Te Tiriti o Waitangi (the Treaty of Waitangi) is the founding document for New Zealand, the basis on which the partnership between Māori and the Crown was established. The Kāi Tahu raketira Karetai and Korako signed the Treaty at Pukekura (Tairaroa Head) on 13 June 1840. Kāi Tahu considered that the Treaty bound the whole tribe of Kāi Tahu irrevocably to an agreement which imposed responsibilities on both signatories, the Crown and Kāi Tahu. The Otago Regional Council has an established relationship with Kāi Tahu based on the treaty partnership. Partnership between the ORC and Kāi Tahu embodies the principles of the Treaty of Waitangi in decision making and local environmental management.

³ In the south of the South Island, the local Māori dialect uses a ‘k’ interchangeably with ‘ng’. The preference is to use a ‘k’ so southern Māori are known as Kāi Tahu, rather than Ngāi Tahu. In this document, the “ng” is used for the iwi in general, and the “k” for southern Māori in particular.

Waianakarua River morphology and riparian management strategy - overview

Purpose

- To provide guidance to landowners, stakeholders, iwi and the community for good decision-making and appropriate activities within the riverbed and on the riparian margins of the Wainakarua.

Vision

- The long-term sustainable use and enjoyment of the Waianakarua and its riparian margins.

Functions

Appropriate guidance and active engagement to empower good decision-making. Ensure activities are undertaken in a sustainable and appropriate manner.



The wise use of resources to:

- Manage the risk to property and assets
- Enable sustainable gravel extraction
- Protect and enhance community values
- Improve community resilience.

Understand natural river processes and morphological characteristics, and the potential effects of those on the river and its margins.



A shared vision of the river's values and features to be utilised, preserved and enhanced.

Waianakarua morphology and riparian management strategy - overview

Objectives & associated activities (these are further refined in Section 8 - implementation)

1. To recognize and characterize natural river processes.	2. To equip the community to live with the effects of changes in river morphology.	3. To enable sustainable gravel extraction.	4. To promote activities that enhance natural character and enjoyment of the river.
<p>Collect information about flood and erosion processes.</p> <p>Report on changes in channel morphology.</p> <p>Provide information to the community</p> <p>Identify the location of river corridors, within which the river will naturally meander.</p>	<p>Promote land-use practices and the placement of assets that reduce the risk associated with changes in riverbed morphology.</p> <p>Consider all available options to manage the effects of bank erosion, including structural and non-structural options.</p> <p>Enable works that will, where necessary, improve the conveyance of floodwater and 'train' the river within its natural corridor, without compromising the features that are of high value to the community and iwi.</p>	<p>Identify areas where gravel accumulation can naturally occur.</p> <p>Identify areas where permanent removal of gravel may have a detrimental effect on assets, riverbed morphology or community values.</p> <p>Identify minimum bed levels/profiles, below which extraction will not occur.</p>	<p>Provide maps showing the location and characteristics of features that are of high value to the community.</p> <p>Encourage the establishment of riparian plantings that are practical and appealing.</p> <p>Provide access and habitat for fishing and white-baiting activities.</p> <p>Support pest and weed control activities.</p> <p>Discourage dumping, and arrange the regular collection of rubbish.</p>

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1. Introduction

Changes in the morphology (physical form) of riverbeds occur as a result of natural processes that are often uncontrollable, and also from human intervention. The Waianakarua riverbed is an integral part of the wider Waianakarua River catchment (Figure 1). The Waianakarua riverbed is part of a dynamic river system, and has experienced changes in morphology in recent decades. These changes will have occurred in response to naturally occurring flood events, as well as gravel extraction activities and historic river management decisions. Changes to riverbed morphology have included degradation⁴ and sedimentation within the main channel (Figure 2) and significant bank erosion in places (Figure 3). In some cases these changes have negatively affected the values placed upon the river by the community, iwi and stakeholders (landowners, Fish & Game New Zealand, Department of Conservation (DoC), Waitaki District Council (WDC), and residents).

Land alongside the river channel is often referred to as the 'riparian margin'. More intensive use of the land that borders the river has occurred in recent decades, with valuable farmland replacing what was previously rough vegetation. As a result, changes in the position and form of the riverbed can cause issues for landowners and other river users. The Waianakarua River is valued as a recreational, commercial, and cultural resource e.g. swimming, walking, fishing, and farming.

The Otago Regional Council (ORC) has proposed the Waianakarua River morphology and riparian management strategy ('the strategy') to help provide guidance (for all users of the river) for good decision-making and appropriate activities on the riverbed and riparian margins of the Waianakarua River. The strategy has a vision of long-term sustainable use and enjoyment of the Waianakarua riverbed and its riparian margins. It is also important when undertaking activities within the riverbed and on the riparian margins of the Waianakarua River that people recognise, and allow for, the traditional, spiritual, and cultural values of local iwi.

The strategy's key objectives are to:

- Recognise and characterise the natural river and catchment processes that occur in the Waianakarua River
- Equip the community to understand, and live with, the effects of changes in river morphology
- Enable sustainable gravel extraction
- Promote activities that enhance the natural character and enjoyment of the river.

The strategy is also intended to guide the nature and extent of land-use, so that the negative effects of morphological changes in the riverbed do not increase and, where possible, are progressively reduced. It provides a framework for decision-making, so that activities undertaken by people occur in such a way that the results are:

⁴ The term 'degradation' in this case refers to the wearing down of the channel by the erosive action of water.

- A visually appealing river system
- A habitat that supports existing wildlife, fish, and preferred plant species
- Limited effects on assets as a result of flood events
- Resilient infrastructure (roads, bridges, water supply)
- Continued use of the river for recreational activities.

Many of the actions listed in this strategy are voluntary and will rely on interactions between the key stakeholders, iwi and the community to be successful. It is therefore recommended that people who live, work, or play in the Waianakarua River catchment consider, and give effect to, the principles, objectives, and actions listed in the strategy.

1.1. Report outline

Section 2 describes the scope of the strategy; while Section 3 summarises the natural environment within which it sits and Section 4 summarises the community values associated with the river⁵. Section 5 describes the legislative context within which the strategy has been defined and will operate. Section 6 outlines the strategy's guiding principles and core components. Section 7 outlines the work that ORC has undertaken to help define an appropriate and sustainable river form for the riverbed and riparian margins and summarises the methods that the various parties (ORC, stakeholders, iwi and the community) have designed to meet the strategy's key objectives.

A series of appendices are included at the end of this document:

- Appendix 1 describes the physical river management work to be undertaken by ORC in the next three years, which will also assist in achieving the strategy's objectives.
- Appendix 2 describes the areas where gravel has been identified as naturally accumulating and the river management profiles which have been calculated for those areas.
- Appendix 3 contains a guide on planting on river banks
- Appendix 4 contains the mapped river corridors (the active fairway, and buffer zones).
- Appendix 5 contains the mapped community values for the Waianakarua River
- Appendix 6 provides a summary of the public feedback received in late-2016 and early-2017 regarding what they value from the Waianakarua River.
- Appendix 7 contains information from the consultation with landowners, treaty partners and stakeholder groups in 2016 - early 2017.
- Appendix 8 contains the Cultural Values Report provided by Aukaha.

⁵ As determined by landowners, stakeholders, iwi and members of the public during community consultation in October 2016 and April 2017.

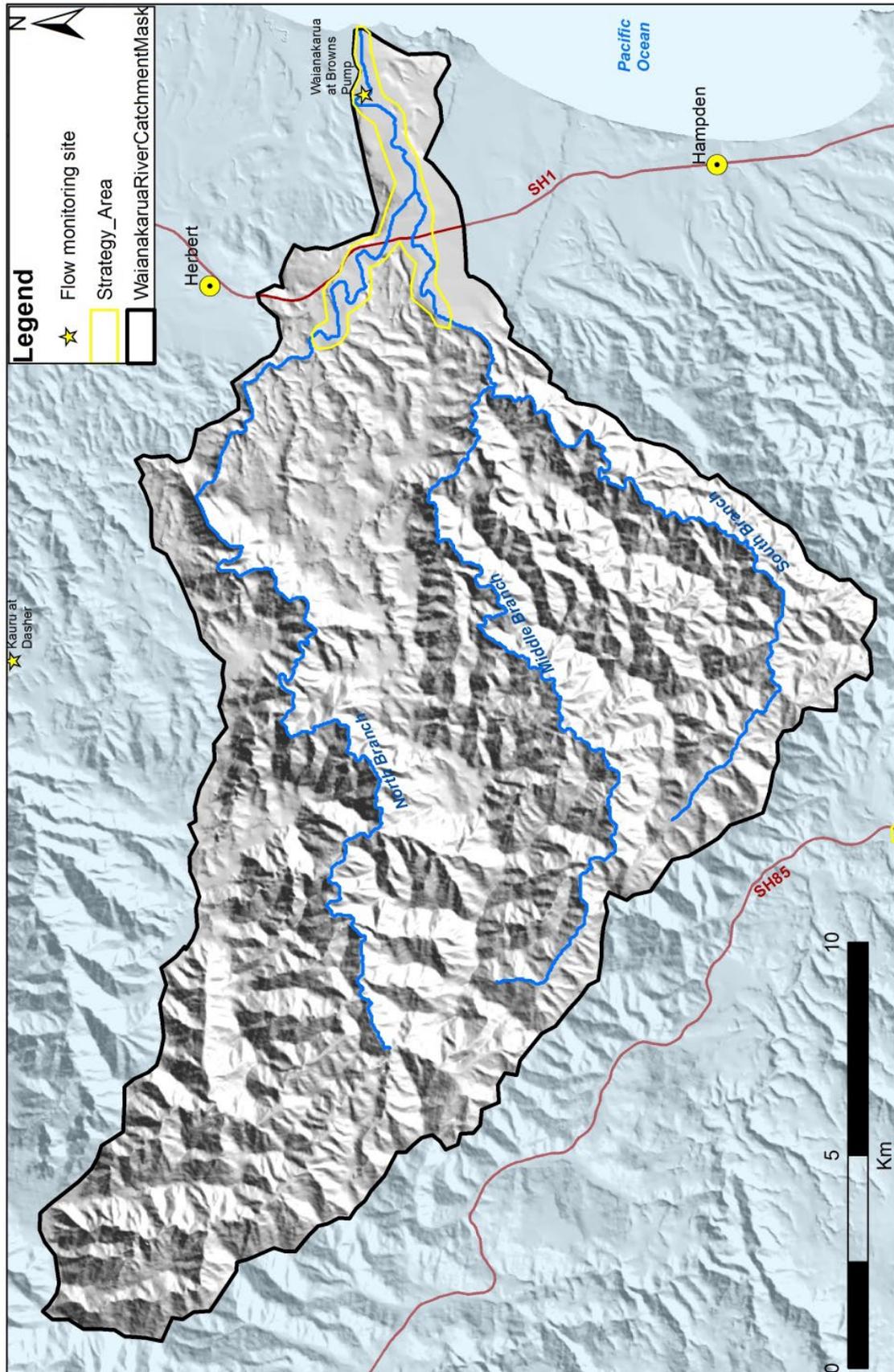


Figure 1. Waianakarua River catchment boundary, showing the main tributaries and reaches of the river to which this strategy applies.

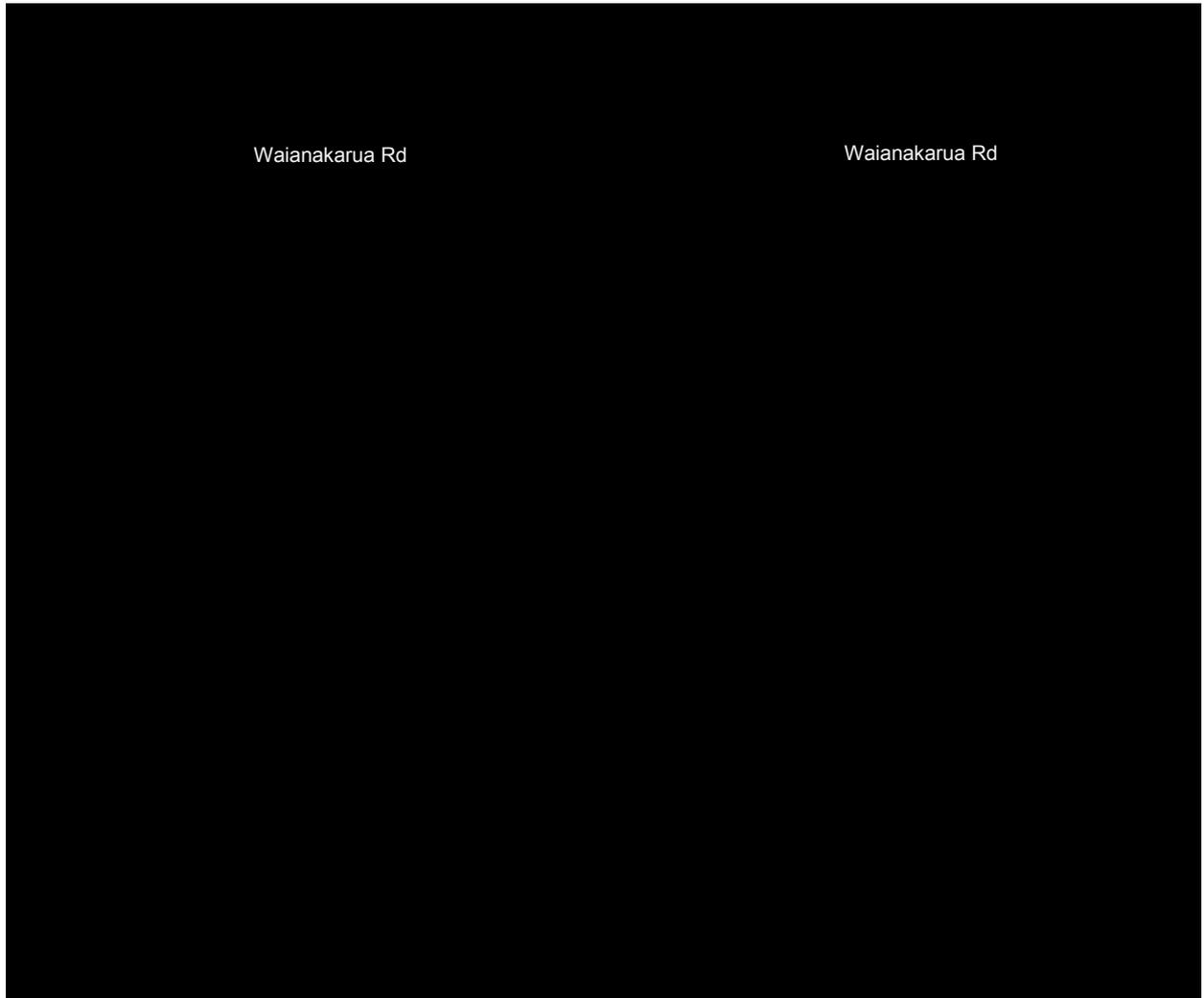


Figure 2. Comparison of aerial photographs illustrating lateral shifts in the channel position and gravel build up at the confluence of the North and South branches of the Waianakarua River. Aerial photography collected in 2006 (left) and 2014 (right).



Figure 3. Examples of changes in channel morphology. Top: Bank erosion on the true-left bank of the Waianakarua River (Summer 2014/15). Bottom: Bank erosion at a bend of the Waianakarua River adjacent to Waianakarua Road. The establishment of invasive weed species on the inner bend of the channel, reduces the lateral confines of the channel.

2. Scope

2.1. Study reach

The geographical scope of the strategy is the reach of the Waianakarua River North Branch from Graves Dam and the Waianakarua River South Branch from McKerrow Road to the confluence with the Pacific Ocean (Figure 4). The upper reaches and tributary streams were not investigated in this report as most concerns previously raised by the community were located in the study reach as well as the steeper upper catchment topography limiting management opportunities. The focus was therefore on this location. Other areas in the Waianakarua River catchment may also experience problems and issues associated with river processes; however these are not examined here.

2.2. Risk

The strategy has a focus on the risks and effects associated with changes in riverbed morphology (including channel degradation and bank erosion, sedimentation, and flooding) in the study reach of the Waianakarua River. However, it is acknowledged that heavy rainfall events may lead to a range of other risks, including widespread flooding and surface runoff.

There are several other environmental issues and hazards in the Waianakarua River catchment. These include natural hazards such as seismic activity, as well as water quality and quantity issues. While numerous other issues do exist, this strategy is primarily concerned with the negative effects of changes in river form on the values associated with the Waianakarua River. Guidance and regulations relating to other issues can be obtained from the ORC.⁶

⁶ For example, the Otago Natural Hazards Database, the Water Info website and the Regional Plan: Water for Otago; all available from www.orc.govt.nz



Figure 4. Map showing the branches of the Waianakarua River and the reaches of the Waianakarua River to which this strategy applies.

2.3. Strategy development

The strategy is intended to be a living document, which will evolve in response to new information and changes in river morphology,⁷ the needs of the community, and the work of the ORC and other stakeholders. It will be reviewed regularly as part of council's annual and long term planning process, or in response to large flood events. The review process will involve landowners with property alongside the river, other stakeholders, and ORC staff with responsibilities for river and waterway management and natural hazards. The review is proposed to monitor the effectiveness of the strategy, the workability of its stated objectives, and to note progress towards achieving those objectives. It will also help ORC to set priorities when considering funding and undertaking river-maintenance work in the rivers concerned.

Before the review process, ORC will arrange and facilitate a workshop with the local community and invited stakeholder groups. This will consist of two parts:

- An opportunity for participants to present to the group any issues they face as to changes in channel morphology or riparian management; work they have undertaken or would like to see undertaken; or to discuss, question or suggest changes to the strategy itself.
- A facilitated process to coordinate activity and work towards achieving the principals and objectives outlined in the strategy.

⁷ Including additional understanding gathered during future flood events

3. Environmental setting

The natural and social settings of the Waianakarua River catchment are described in this section, with particular focus on the special characteristics that give rise to the risks associated with changes in riverbed morphology.

3.1. Geological and soil setting

The geology of the upper catchment (Figure 5) consists mainly of semi-schist (Forsyth 2001). The lower catchment is mainly sandstone and mudstones with alluvium overlying the bedrock. Below SH1 the geology consists of river gravel/alluvium and volcanics (Deborah volcanics), however most of the surface water in this geology drains into the Bow Alley Creek catchment (Forsyth 2001).

There are a number of visible geological features, especially within the lower reaches of the catchment. They include the large boulders above Awanui Bluff; the cliffs near the mouth of the joint rivers; the cliffs up from Graves Dam; the Katiki Boulders; and the waterfalls in the forested tributaries (ORC, 2008).

The Waianakarua catchment is comprised of a variety of soil types. A variety of upland and high-country soils are found in the upper catchment, while shallow silt loams are predominantly found in the lower catchment. The presence of silt loams in the adjacent rolling country makes these areas more susceptible to erosion events (ORC, 2008).

Figure 5. Geological map showing the main rock types for the reach of the Waianakarua River, for which this strategy applies; and the surrounding catchment.

3.2. Geographical setting

The Waianakarua River (Waianakarua meaning 'between two rivers') has a catchment area of 262 km² and consists of three tributaries: the South Branch, Middle Branch, and the North Branch (Figure 5). The South and Middle branches arise in the Horse Range and join near the base of the ranges on the western side of State Highway 1. The North Branch arises in the eastern Kakanui Mountains and joins the South Branch approximately 5 km's from the coast, downstream of State Highway 1. Vegetation in the upper catchment (Figure 6) is mostly tussock and scrub which is extensively grazed (ORC, 2013). The vegetation in the Middle and South branches is mainly mixed native bush as well as some plantation forestry; the North Branch consists of a greater proportion of plantation forestry as well as large areas of native bush and scrub (ORC, 2013). The lower catchment is covered in agricultural grazing land (ORC, 2013).

The three branches of the Waianakarua River consist of confined, meandering channels cut into schist bedrock with a mixed gravel and bedrock bed (ORC, 2008). The lower catchment is mostly wandering with a section of braiding that is incised into an elevated gravel floodplain (ORC, 2008).

Patches of native podocarp and kowhai forest remnants exist within the catchment along with extensive areas of exotic forestry, pasture grasses and tussock grassland (ORC, 2008). The vegetation structure has changed significantly over time with changing land uses.



Figure 6. Upper Waianakarua catchment (photograph taken December 2016).

3.3. Meteorological setting

Flood events within the Otago east coast catchments such as the Waianakarua are generally caused by persistent rain bearing easterlies, with continual rainfall over days saturating the soil, leading to rapid runoff (ORC, 2015). Generally, these types of events occur in late summer to late autumn, although they can occur at any time (ORC, 2015). The nearest long-term automatic rain gauges are located in the Kauru River catchment at the Dasher. Annual average and maximum daily rainfall totals for these sites are listed in Table 1.

Table 1. Annual average and maximum observed daily rainfall total for rain gauges within and near the Waianakarua River catchment.

Hydrological monitoring site (rain) (date record commences)	Annual average rainfall (mm)	Maximum daily rainfall (mm)	Date of peak 24 hr rainfall
Kauru at the Dasher (1953-2016) (missing record 1995)	808	199	12 Jan 2002
Herbert Forest (1967-1989)	661	184	9 Mar 1968

Rainfall information dating back to the mid 1930's indicates that the median annual rainfall in the catchment is highly variable ranging from 400 mm in the lower catchment to 1500 mm in the upper catchment. Generally, most rainfall occurs in the periods June to August, and December to January, and the catchment can be subject to long dry periods in summer and autumn. There appears to be a direct correlation between an increase in rainfall and distance from the coast.

3.4. Hydrological setting

The Waianakarua has a variable river flow, with seasonal low flows and periodic flushes. The North branch is higher yielding with a more consistent flow, while the South Branch has been shown to be the driest. The South Branch may occasionally run 'dry' or underneath the gravel surface naturally, however this is not a feature of the whole river system.

Information on river flow in the Waianakarua River is available from one monitoring site (see Table 2). The Browns Pump recorder has been operating since 2005. Permanent flow recorders were not installed in the Waianakarua River catchment until 2005; as a result flow records are short and should be treated with some caution (ORC, 2006). The five largest flows on record for the Browns Pump recorder are shown in Figure 7. The Waianakarua River can rise rapidly during flood events, with a rate of rise greater than 1.80 metres per hour observed. Average velocities observed at this site (based of gauged flows) range from 0.1 to 2.1 metres per second, with velocities likely to be higher in the steeper, more confined sections of the Waianakarua River.

Table 2. Summary of hydrological information for sites within the Waianakarua River catchments

Hydrological monitoring site (river flow) (date record commences)	Maximum observed flow (m ³ /sec) (date occurred)	Annual flood (2.3 year return period) (m ³ /sec)	Median flow (m ³ /sec)
Waianakarua River at Browns Pump (2005-2016)	635 (17 Jun 2013)	276	0.95

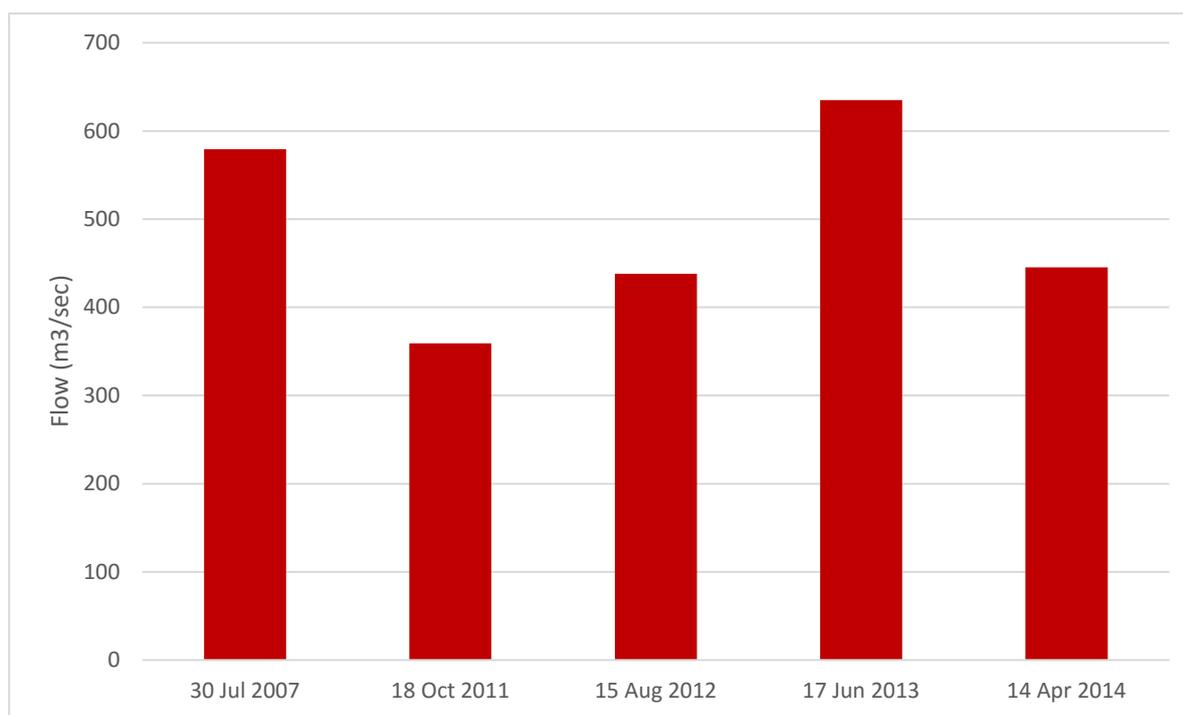


Figure 7. Five highest flows in the Waianakarua River at the Browns Pump flow recorder, since records began in 2005.

3.5. Flooding

Changes in the morphology of the Waianakarua River channel are in part, driven by the hydrological characteristics of the river, including the magnitude and frequency of flood flows. The Waianakarua River has experienced large flood events in the past, with the Jun 2013 flood being the largest on record. Land loss in the Waianakarua catchment is mainly due to erosion and slumping associated with high flow events; whilst no buildings are known to flood (ORC, 1991, 2002). Figures 8 and 9 show the Waianakarua River in flood, where water has escaped the main channel because of the high flow event. Adjustments in the position of the channel can also result from high events. In December 1993, the main channel of the Waianakarua River developed a new course down the left side bank at Sharpes Bend. State Highway 1 was subsequently threatened by undermining and then again in 1994, when further erosion resulted on the true left bank

The mapped flood hazard for the Waianakarua River is shown in Figure 10. The flood hazard mapping is primarily based on observed flood extents and is not completed using modelling or topographic information (ORC, 2002).



Figure 8. Flooding of farmland on the true left bank of the Waianakarua River, downstream of the confluence of the North and South branches (photograph taken in the morning of 19 April 2014 by Jill and Grey Campbell).



Figure 9. Flooding of farm land on the true left bank of the North Branch of the Waianakarua River, upstream of the confluence of the North and South branches (photograph taken in the morning of 19 April 2014 by Jill and Grey Campbell).

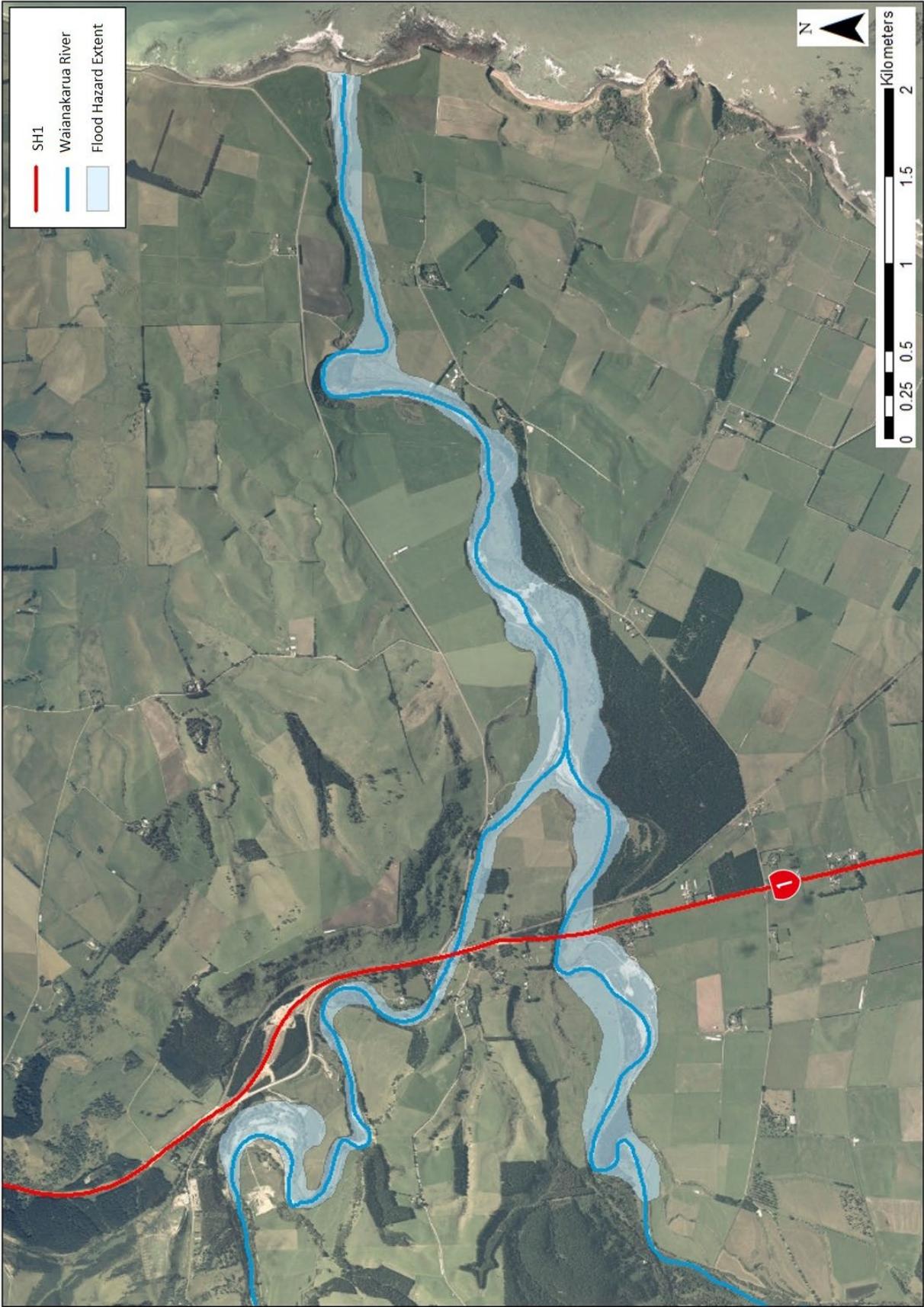


Figure 10. Waianakarua River flood hazard extent (ORC, 2002).

3.6. Riverbed morphology

The active channel of the Waianakarua River is a dynamic system where flood events and sediment transport regularly cause changes in riverbed morphology. Changes in the longitudinal profile of the riverbed occur due to aggradation and degradation along the channel, and as a result of lateral bank erosion. Significant changes often occur as a result of extreme flood events, but small scale, incremental changes can also occur over longer timeframes. Human activities, such as gravel extraction and physical works, can also result in significant morphological changes, particularly near these works, but they can also occur across the wider river system.

ORC undertakes work to describe these changes in morphology using visual inspections, aerial and ground photography, and cross-section analysis. Reports summarising these investigations were published in 2008 and 2013 (ORC 2008, 2013).

Observations of the Waianakarua River in 2016 and 2017 by ORC staff helped to reinforce the findings of previous investigations, in particular:

- There are several locations along the river where bank erosion is ongoing. Many of these sites are not captured by ORC's cross section network.
- The river is experiencing both aggradation and degradation and is affected by natural and human processes.
- Gravel moves downstream gradually and is shifted in large quantities during flood events.
- There are areas of significant riparian plantings and other areas where there is limited vegetation cover. The riverbed changes between stable reaches where there is riparian planting and limited bank erosion and areas where there is limited bank vegetation and ongoing bank erosion.
- The encroachment of weeds on the inside of river bends; locks up gravel and narrows the confines of the channel. This can promote bank erosion on the neighbouring bank of the channel (Figure 12).

A comparison between aerial photography collected in 2004 and 2016, highlight the dynamic nature of the Waianakarua River (Figures 11 and 12). Cross section surveys of the channel also show how the channel moved laterally, accumulated sediment on the riverbed and deepened in some locations (Figures 13 and 14). In some places the active river channel has changed positions and eroded into adjacent farmland. The upper reaches of the strategy area are relatively stable, with lateral changes in the channel position only occurring at gravel extraction and river management locations. Significant quantities of gravel have accumulated at the confluence of the north and south branches downstream (Figure 11). Active channels adjacent to the confluence have shifted up to 40 m in response to the build-up of sediment and altered flow pathways (Figures 11 and 12). Between the confluence and 1900 m downstream, the position of the active channel within the fairway has shifted between 30 and 50 m in cases (Figures 11 and 13). Further changes have also been seen before the last meander bend (adjacent to the Waianakarua River) where the position of the channel before it enters the bend has changed.

Figure 11. Comparison of the Waianakarua River fairway between 2007 and 2016 downstream of the confluence between the North and South branches (aerial photograph collected in 2016).

Figure 12. Comparison of the Waianakarua River fairway between 2007 and 2016, for the North Branch, directly upstream of the confluence with the South Branch (aerial photograph collected in 2016).

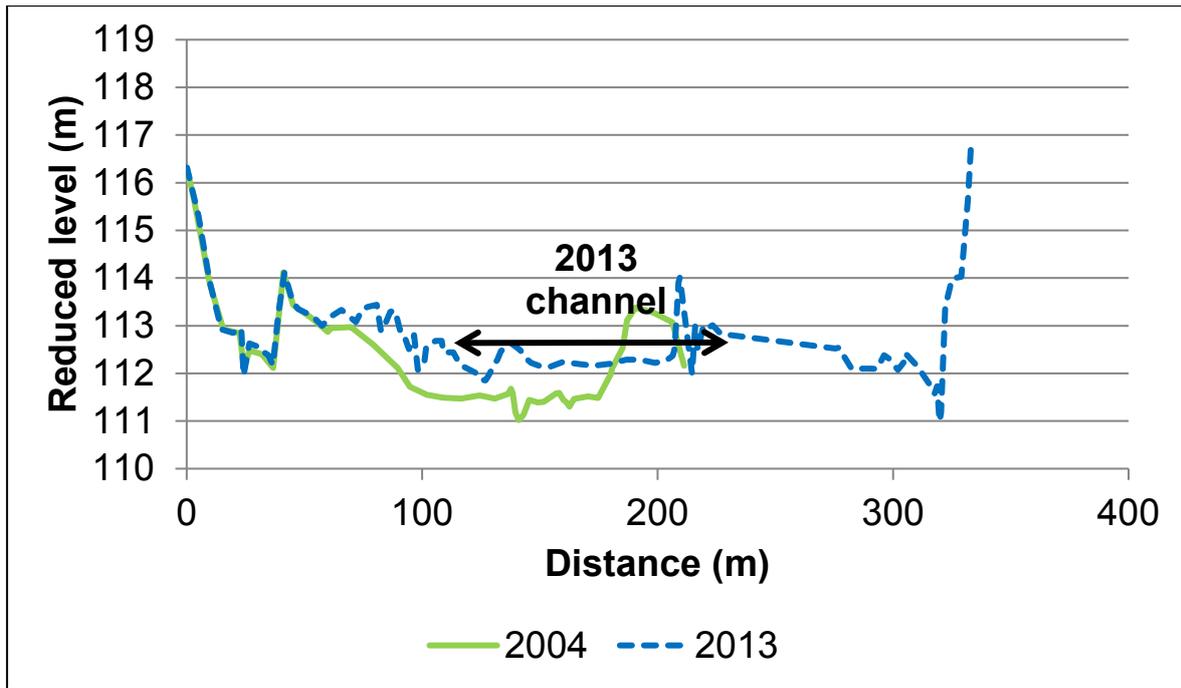


Figure 13. Cross section of the Wainakarua River at WA3 (located downstream of the confluence between the North and South branches), looking downstream. Between 2004 and 2013, the main channel aggraded up to 1 m on the true left and eroded the true right bank by approximately 20 m.

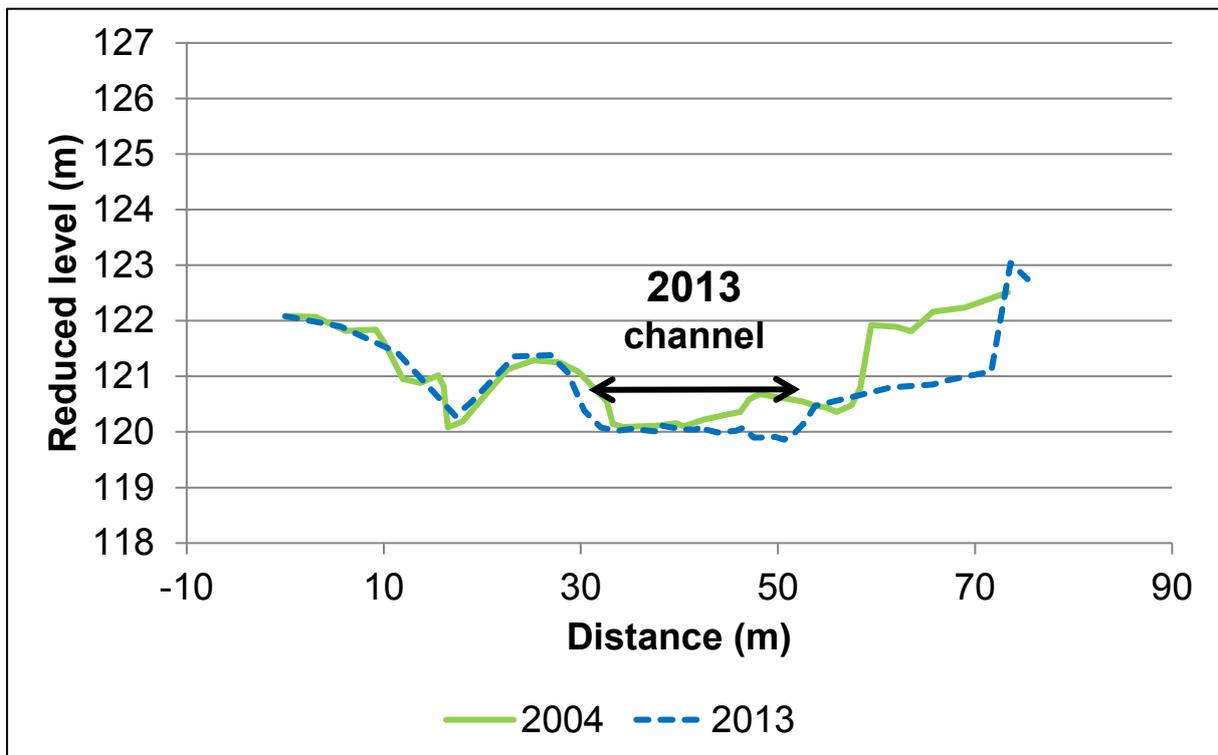


Figure 14. Cross section of the Wainakarua River at WA5S (located upstream of the SH1 bridge on the South Branch), looking downstream. Between 2004 and 2013, the main channel degraded by 0.7m on the true right. Bank erosion occurred on both banks adjacent to the main channel, where the right bank eroded by approximated 14m .

3.7. Riparian margins

The riparian margin is the area beside waterways that forms the interface between water and land. As noted in the introduction, more intensive use of the land that borders the Waianakarua River has occurred in recent decades. In some parts of the catchment, farmland has encroached onto what was previously a more natural area of rough vegetation. This has resulted in a narrowing (or in some cases, complete removal) of the riparian margin that separates the active river fairway from land that is used for farming, or which accommodates community infrastructure. Previous ORC reports have identified that channel widening by bank collapse and erosion are processes that continue to occur in the Waianakarua River (ORC, 2013). The loss of primary agricultural land and physical property adjacent to eroding stream banks is very costly and the need for their protection against erosion has long been recognised.

Historically, the permanent removal of gravel from the river system has been used as a tool in an attempt to address bank erosion issues. The strategy identifies that gravel extraction, and other river management tools (such as the movement of gravel within the channel and spraying), should still be considered for river management purposes, where that is appropriate. However, a number of authors have identified that the most effective means of controlling river bank erosion is to establish a vegetative cover of strongly rooting plants (Slui 1991, Marden *et al.* 2005, ORC 2005, Phillips & Daly 2008). In general terms, vegetation roots increase bank stability by protecting soils against entrainment from flood flows, and root mass and density provide soil shear strength, thereby protecting against gravity collapse of undercut banks.

Other indirect benefits of riparian plantings include trapping nutrients and fine sediment, shade, shelter and filtering qualities for the aquatic eco-system, as well as aesthetic and recreational value. If well managed, riparian margins can help to improve water quality, provide food and habitat for freshwater life, and improve diversity (ORC, 2005).

4. Values

The Waianakarua River is one of the few rivers left in North Otago with a high water quality, which supports a diverse biodiversity; including vulnerable native fish and remnants of native vegetation. It is important for the viability of commercial farming and gravel extraction operations, and has many recreational users. Every aspect of the river is important, and all aspects of the river must fit together. The river and its catchment must be managed in a coherent and integrated way, with regard to all values.

Information on the values that the community, iwi and stakeholders have for the Waianakarua River was collected through community meetings and collecting feedback (Appendices 6 and 7). The Waianakarua River fulfils a number of important roles within the community at a local, district, and regional scale. These roles include (but are not limited to):

- A source of water for irrigation, stock, and people (e.g. town water supplies).
- A source of gravel for roading and construction purposes.
- For recreational purposes, including swimming, fishing, whitebaiting (ORC, 2006), picnicking and camping. The Waianakarua is a popular recreational destination for people who live outside of the local community (e.g. people from Oamaru, Dunedin).
- A habitat for native and introduced species.
- For customary use by local iwi ranging from the use of water for ceremonial purposes, to maintaining the quality and quantity of water to sustain mahika kai populations and habitat.
- Mana Whenua values including kaitiakitanga, mahinga kai, ki uta ki tai and mauri

Limited information was collected on the spatial location of the values discussed and presented by the community and stakeholders. The lack of geographical information on the values discussed in this strategy therefore means all values should be considered whenever activities are planned for the beds and banks of the Waianakarua River at any location.

The below sections discuss the ecological, community, Māori cultural and historical values that are held for the Waianakarua River.

4.1. Ecological values

Wetlands

The Waianakarua River Estuary Swamp is believed to have significant wetland values and has been classified as a regionally significant wetland in Schedule 9 of the Water for Otago Regional Plan. Bank vegetation and long grasses provide spawning habitats for īnanga (whitebait) spawning during floods or high tide events.

Fish

The Waianakarua River provides an important habitat for a range of native and exotic freshwater species. It provides one of the best Otago Rivers for fish diversity and abundance, and associated recreational opportunities. Recognition of this habitat has previously seen the transfer of a number of endangered Lowland longjaw galaxias into the mid reaches of the Waianakarua. Their classification as nationally critical, is the highest threat category. There are over 14 species of fish being present in the catchment (NIWA freshwater fish database, ORC 2013). Seven species are classified as 'at risk' and 'declining' in the New Zealand Freshwater Fish Threat Classification (ORC, 2013) and include longfin eel, Torrentfish, bluegill bully, redfin bully and two migratory galaxiids (īnanga and koaro). Other species include three species of bully (common, upland and giant), two non-migratory galaxiids (Canterbury galaxias and the Lowland longjaw galaxias), smelt, shortfin eel, black flounder, and brown trout (ORC, 2006). Lamprey are threatened and are ranked as nationally vulnerable; the third highest threat classification given to threatened species.

Brown trout are the only species of introduced sports fish found in the Waianakarua River catchment (ORC 2006). The Waianakarua River is not considered a significant sports fishery, but has seen an increase in angler effort over the 15 years (Table 3). Information from Fish and Game Central South Island recognises that the Waianakarua River is a limited sports fishery due to the lack of cover and low flow (Pringle 2003). The Waianakarua River trout fishery is believed to be heavily dependent on the sea run component (Pringle 2003).

Spawning and incubation periods are an important consideration when undertaking river works. Spawning success is dependent on adequate river flows and appropriate substrate. Interstitial spaces should be present between coarser gravels, where the sedimentation of finer particles is limited. For brown trout, this spawning period extends from the start of May, until the end of September (Central South Island Fish and Game Council, pers.comm., 27 June). Redd environments and the incubation process are sensitive to physical disturbance and silt deposition during these periods.

Table 3. Angler effort in the Waianakarua catchment (angler days +/- standard error) based on the national angler survey (Unwin, 2016)

River	Angler usage (angler days +/- SE)			
	1994/1995	2001/2002	2007/2008	2014/15
Waianakarua		140 +/- 140		280 +/- 230

Birds

The Waianakarua catchment provides sanctuary for a range of native fauna including the jewelled gecko (Kakanui Mountain), piwakawaka (fantail), korimako (bellbird), kereru (pigeon) and tui (ORC, 2008). Black-backed gulls also nest above the gorge. Avifauna which utilise habitats along the lower Waianakarua River and its mouth, are suspected to be relatively close to that of the Kakanui River (located several kilometres north) (ORC, 2015). Birds include the white-fronted tern, banded dotterel and the South Island oystercatcher.

Modification of the river bed and margins of the Waianakarua River, threaten the habitats of these species. Human activities in and around the river bed may also disturb nesting birds.

Mana Whenua Values

Ngā Rūnanga hold strong positions regarding riparian management and protection of the fish species in the Waihemo, especially in regard to mahinga kai. This includes the use of taonga species for riparian planting, planting that provide habitat for mahinga kai species, protection of native spawning fish, protection of disturbed fish, allowing passage for migration and minimising sedimentation in the river. For more information on these positions see appendix 8.

4.2. Community

To help identify aspects of the wider river environment that is important to the local community, ORC consulted with a range of stakeholders in 2016 and again in 2017. These included landowners, Central South Island Fish and Game Council, the Waitaki Branch of Forest and Bird, Department of Conservation (DoC), and WDC. ORC also consulted with Te Rūnanga o Moeraki through Auhaka in 2017 and into 2018.

The Waianakarua River has a long connection with Maori culture, as well as European settlement. In addition to the natural character of the river and its margins, amenity values are supported by the important natural values of the river. Community values include:

- Clear, high quality water adds to the aesthetic appeal of the river
- The Waianakarua provides an environment for fishing, white baiting, game bird hunting, utilising water holes for swimming, recreation and family gathering
- Utilising swimming holes
- Source of clean drinking water and stock water
- Irrigation is important for some farming operations
- Being able to manage the river through the use of gravel extraction and tree planting
 - o Extracting gravel for use (i.e. an aggregate supply) and for river management purposes. Gravel has previously been extracted to improve the conveyance of flood flows and to reduce outer bank erosion.

Values that the community and other stakeholder groups identified with the Waianakarua River environment have been summarised around community river form and function 'values' as summarised in the box below. A full list of feedback and these values that have been identified through the consultation process are included in Appendices 6 and 7.

Community river form and function ‘values’

- That the function of the river continues to support social, cultural, spiritual, ecological, recreational, and farming activities – as well as continuing to provide for the taking of gravel as a resource.
- That the form of the river includes riparian plantings (including both native vegetation and willows), weed control and fencing.

4.3. Mana Whenua Values

To understand the cultural importance of the wider river environment to the local Iwi, ORC have worked in partnership with Te Rūnanga o Moeraki through Aukaha (formerly KTKO).

Values identified have been summarised in the box below. More information on Mana whenua values and perspectives on freshwater, association with the Waianakarua, Ngā Rūnanga aspirations relevant to the strategy, issues for Ngā Rūnanga relevant to the strategy and recommendations that have been identified through the consultation process are included in Appendix 8.

Mana Whenua Values

Ko te wai te ora ngā mea katoa. Water is the life giver of all things

- Kaitiakitanga is the responsibility of Mana Whenua to ensure that the life-supporting capacity (mauri) of the natural resources of their takiwā is sustained.
- Mahinga Kai literally means “food workings” and refers to the places where food is gathered or produced, the traditions and collection methods associated with gathering natural resources for cultural use and the resources themselves.
- ‘Ki uta ki tai’ a holistic culturally based ‘mountains to the sea’ natural resource management framework.
- Mauri or life force of all things living and non-living must be protected.

4.4. Historical

Several historical landmarks utilised the Waianakarua River in the lower catchment. The Waianakarua Bridge (Figure 15) (formerly known as the Otepopo Bridge) was established over the North Branch in 1874, to provide a reliable transport connection between the settlements of Dunedin and Oamaru. One of the oldest bridges remaining on New Zealand’s state highway network; the twin-arched stone bridge was designed by John Turnbull Thomson and built using limestone (Heritage New Zealand Pouhere Taonga). The

Waianakarua Bridge holds a New Zealand Historical Places Trust classification, as a monument of national importance. Thomson also designed the bridge over the South Branch, which was completed in 1861.

The water wheels of two historic flour mills utilised the flow of the North Branch of the Waianakarua River. The remains of the former Fernyhaugh Flour Mill (constructed in 1870), are located immediately upstream of the Breakneck Road bridge, which includes a curved stone dam (Heritage New Zealand Pouhere Taonga). Damming occurred twice at Grave's Dam in the 1870's, but currently does not impede river flows. The Phoenix Mill (Figure 16) was also built adjacent to the Waianakarua Bridge in 1879, using quarried stone blocks.



Figure 15. The historic Waianakarua Bridge, built over the North Branch of the Waianakarua River in 1874 (Image courtesy of Nicola Jackson, Heritage New Zealand Pouhere Taonga).



Figure 16. Historic flour mill located adjacent to the North Branch of the Waianakarua River (Image courtesy of The Mill House).

4.5. Gravel extraction

The removal of gravel from the bed of the Waianakarua River has occurred for many decades, with extracted material generally used for farm laneways, roading and construction. Gravel extraction typically occurs from locations where sediment accumulates e.g. where there is a decrease in the gradient of the river, leading to a reduction in the velocity of flood flows, or in an attempt to mitigate issues such as bank erosion. In either case, extraction from the bed of the river will tend to increase the conveyance of water during flood events by widening the channel and reducing the mean bed level (MDL)⁸ at that location. It can also lead to a decrease in the sinuosity of the river channel, as bends are straightened in an attempt to reduce the effects of bank erosion.

The Waianakarua River has previously been identified as having limited gravel supply rates (ORC 2004). Gravel extraction and past flood events have contributed to localised erosion and aggradation (ORC 2008) as well as degradation of the channel bed (ORC 2004). Gravel extraction is carried out on the North Branch, the South Branch and the main stem of the Waianakarua River. Localised gravel extraction from areas of high accumulation, is used to assist the conveyance of flood flows and by keeping the river in its assessed fairway, reduce bank erosion. River morphology reports and the monitoring of gravel extraction by the ORC, is used to ensure sustainable gravel extraction in the long term, which balances river management requirements and instream values (see ORC 2008 and 2013).

Gravel extraction within the study reach has been occurring over several decades. Between 2004 and March 2017 about 93,035 m³ of gravel has been extracted. 26,463 m³ was extracted between 2014 and March 2017. Currently a total of 28,000 m³ per year of gravel is consented to be removed from the Waianakarua River from extraction locations at Sharpes Bend, upstream of Herbert-Hampden road on the south branch, the confluence of the North and South branches and 900 metres downstream of the confluence.

Gravel that is removed from the Waianakarua River system in excess of the natural replenishment rate can lead to instability and reduced integrity of structures downstream. This includes undermining of river protection works and other assets (e.g. water intakes, bridges, and roads) as well as increased bank erosion and bed degradation. It is important to recognise that gravel beds are still of value to a wide range of species and perform critical ecological functions.

Ongoing channel degradation can allow increased water velocities (particularly during flood events) to scour the river bed, deepening the channel, which can result in continued bed degradation. As the channel deepens, flood flows become confined within the channel and continue to scour the bed. This ongoing degradation decouples the channel from the floodplain and alters the floodplain catchment interactions (Fuller *et al.* 2014). Deeper channels contain larger floods and concentrate flows, leading to more incised channels, potentially generating higher sediment transport rates (due to bank erosion and further removal of material from the riverbed). This process gives the appearance of more prominent gravel bars within the active channel due to the deeper channel. As the channel deepens and gravel bars become more prominent, pressure is often exerted by adjacent landowners

⁸ MBL represents a 'horizontal straight line across the channel, positioned so there is as much bed above the line as below it' (Griffiths, 1979).

to remove the obvious (but in fact non-existent) excess gravel accumulation, which in turn exacerbates the degradation trend (Fuller *et al.* 2014).

The permanent removal of gravel can also result in the undermining of river protection works and other assets (e.g. water intakes, bridges and roads), as well as degrading ecological values. Gravel extraction can have a negative effect on the local ecology, with the severity of effects dependent on the extraction methods used and the environment from which the gravel is being extracted. Gravel extraction activities can lead to a reduction in habitat heterogeneity/diversity, an increase in fine sediment, as well as bed compaction that can have a negative impact on the native and exotic animals residing in and on the banks of the Waianakarua River. Over-extraction of gravel can remove potential spawning sites and limit spawning success within the catchment, due to the removal of aggregate and reduction in the size of gravels. This in turn can limit the success of the fishery and recreational opportunities.

The potential beneficial and adverse effects of significant gravel extraction are summarised in Table 4.

Table 4. Potential beneficial and adverse effects of gravel extraction (Canterbury Regional Council, 2015).

<i>Potential beneficial effects</i>	<i>Potential adverse effects</i>
Channel capacity increased, flood levels lowered	Disturbance of fish and bird habitat
Concentration of flow against riverbanks, resultant lateral erosion, and localised bed scour is minimised	Accidental discharge of fuels and lubricants from machinery
Stable channel alignment and optimum bed level is maintained	Disturbance of the natural meander patten and channel stability
Open gravel beaches can provide a good habitat for indigenous birds	Overall degradation of the riverbed
A renewable gravel resource for local construction may be utilised	Increased bank erosion
* Mauri (life force) of the riverbed affected	Sediment is discharged, increasing turbidity and smothering habitat
	Temporary reduction in recreational access
	Mauri (life force) of the riverbed affected

	Disturbance of fish spawning sites
	Dust generation
	Reduced river bed heterogeneity

*Consultation with Auhaka in 2017 indicated 'Mauri (life force) of the riverbed affected' also needed to be added to the Potential beneficial effects side of the table

Sediment replenishment rates from the upper catchment of the Waianakarua River are insufficient to maintain the profile of the surveyed reaches (ORC 2004). The Waianakarua River is currently experiencing ongoing bank erosion as well as areas of both channel widening and narrowing with the largest observed change occurring in the South Branch (ORC, 2013).

5. Future changes

The latest guidance from the National Institute of Water and Atmospheric Research (NIWA) and the Ministry for the Environment (MfE), predicts an increase in daily extreme precipitation and stronger westerly winds (westerlies) for southern New Zealand (MfE, 2016). Warmer atmospheres are able to hold more moisture, which can result in shorter and more intense rainfall events. More precipitation is likely to fall in eastern Otago during winter and spring, due to predictions forecasting an increase in easterly winds.

Understanding changes to the climate in southern New Zealand, is important for forecasting potential changes to the flow regime of the Waianakarua River. More frequent high flow events are likely due to increases in the intensity and total amount of precipitation. Larger floods are more likely, where the Waianakarua may rise rapidly; have a higher peak flow and result in longer duration high flow events. This will place additional pressure on the existing channel, as the channel makes adjustments to incorporate changing flow characteristics.

The upper catchment of the Waianakarua is largely vegetated with tussock grasslands, native bush and exotic plantation forestry (Herbert Forest). The presence of vegetation provides a buffer to rainfall events, which slows the movement of water to the river drainage network. Floods are dissipated, as overland flows take longer to enter the channel; which reduces the magnitude of high flow events and potential flooding. As native vegetation is largely present on conservation land, hydrological changes will most likely result from the harvesting of trees within Herbert Forest. Ongoing harvesting currently occurs in Herbert Forest, due to the mixed age of plantations (Port Blakely, pers.comm., 27 July). In comparison to harvesting rates over the previous decade; harvesting activity is expected to increase into the next decade due to an upcoming “wave” of volume. The impacts of increased harvesting will be minimized if appropriate harvesting techniques are implemented and reforestation occurs.

6. Legislative context

The manner and degree to which the issues in the Waianakarua River can be managed by the community, iwi, stakeholders and local councils is influenced by the obligation, powers and restrictions set out in various statutes. No legislation confers the exclusive power or the right to manage the Waianakarua River to ORC or WDC. Whether through works or services, individuals are empowered to initiate their own measures provided they operate within the law. They are also allowed to develop and promote proposals for bank protection works, to apply for and hold the necessary resource consents, and to privately fund works and services should they wish to.

The law provides for a range of methods that both councils and the community can use to manage the Waianakarua River. These methods do not only relate to physical works, but also to planning, information, emergency preparedness and response. They can only be implemented after taking environmental effects into account (under the Resource Management Act 1991 (RMA)) and funding consideration (under the Local Government Act 2002 (LGA)). The latter includes consideration of the distribution of benefits between the community as a whole, any identifiable part of the community, and individuals.

The Otago Regional Policy Statement (RPS) provides a high-level policy framework for the sustainable integrated management of Otago's resources, as well as giving effect to the requirements of the RMA. This includes the management of the values of water bodies, natural resource systems and the form and function of Otago's rivers, whilst still enabling communities to provide for their needs.

This strategy is concerned with the form and function of the Waianakarua River. Any activities in or on the bed and banks of the Waianakarua River, need to be focused on maintaining or enhancing that form and function. The strategy is not a statutory document; rather it is intended to present the aspirations of the community, iwi and the various stakeholder agencies. However, the statutory processes that do influence river management activities⁹ are more likely to be used effectively and efficiently if there is a general consensus on what is valued about the river, and commonly understood objectives. The strategy sets out the values identified by the community, and the outcomes they seek from managing river form and function, and will be used to inform resource consent decision-making.

⁹ Including the LGA and the RMA

7. Principles

The strategy provides a framework to guide activities and decision-making, based on an agreed set of principles. It is intended to help protect the recreational, cultural and ecological values of the Waianakarua River, and to enable long-term sustainable use of the riverbed and its riparian margins.

ORC has developed the framework, in partnership with iwi and in consultation with the local community and other stakeholders. The principles and associated strategic elements are outlined below, and these are intended to protect or enhance the important values and features of the river identified by the community and other stakeholders.

Principle 1: Ensure sustainable river management

Ensure that:

- There is recognition of the kaitiaki responsibilities of Mana Whenua through clear and consistent communication between Manawhenua and the ORC.
- There is clear and consistent communication between the ORC and other parties.
- There is recognition that certain river and catchment processes, such as flooding, bank and channel erosion and sedimentation, will occur naturally, and an understanding of the potential effects of those processes.
- Any practices undertaken limit exposure to negative natural-river and catchment processes.
- There is an awareness and acknowledgement of the benefits and the risks (including the risk associated with 'super-design' events) that exist for activities such as farming that occur in areas prone to natural-river and catchment processes.
- Any negative effects of natural-river processes do not increase beyond their current levels, and are actively reduced where there is opportunity to do so.
- Activities are managed in a way that result in:
 - Limited effects on assets during flood events
 - Essential community infrastructure that is resilient (roads, bridges, water supply)
 - Acceptable level of effects to farming caused by river processes
 - Sustainable use of river resources
 - There is recognition of the kaitiaki responsibilities of the local iwi.

Principle 2: Plan ahead

Ensure that:

- There is clear and consistent communication between the ORC and other parties
- There is an adaptive approach to river management that will allow for the dynamic nature of the Waianakarua River
- Resources are used wisely to ensure that the location and form of community assets and essential infrastructure will result in a more resilient community
- The impacts of climate change and natural climate variability are considered so that future generations do not have to cope with the results of poor decisions made today
- The risk associated with natural-river processes are reduced over time by taking a broad-scale, adaptive approach over the longer term.
- Decision making considers ecological life cycles and temporal variation in river flows.

Principle 3: Maintain and enhance the natural environment

Ensure that:

- Cultural use by Mana Whenua is enabled, maintained and enhanced by clear and consistent communication between Mana Whenua and the ORC.
- There is clear and consistent communication between the ORC and other parties.
- Activities are managed in a way that results in:
 - A habitat that supports existing wildlife, fish, and suitable plant species¹⁰
 - A more visually appealing river system
 - The ability of the local community and visitors to access and enjoy the river is maintained and/or enhanced
 - Traditional and cultural use is enabled, maintained and enhanced.
 - The consideration of ecological cycles and flow variation.

¹⁰ While native species would be the preferred option and used wherever possible, in some cases a mix of native and exotics may be required to balance river management and biodiversity objectives. See also Appendix 2.

8. River form and habitat enhancement

8.1. River corridor design and management

ORC has undertaken work to identify the location and width of the active fairway (or riverbed), as well as appropriate buffer zones, which together form a corridor within which the river would naturally lie (Williams, 2017). The widths of fairway and buffer zones were completed by assessing the appropriate meander form in relation to the nature and width of the river channel. The design channel has been drawn up using a consistent meander length or wavelength oscillation, while taking into account the existing channel location, channel areas and natural controls and restraints. This work has been undertaken in the Waianakarua River North Branch from Graves Dam and the Waianakarua River South Branch from McKerrow Road to the confluence with the Pacific Ocean (Williams, 2017). An example is shown in Figure 17, and a full set of river corridor maps is provided in Appendix 4.

The river fairway and corridor mapping provides guidance for multi-purpose river management, and for the design and implementation of management measures, protection works and in-channel design. When physical works or activities are being considered within the fairway or on the riparian margin, these should be undertaken with reference to the mapped fairway and buffer zones. Guidance for managing the river within this corridor, and across the wider floodplain, is summarised in Figure 18.

ORC will work towards maintaining the Waianakarua River to the mapped corridor lines in the study reach where reasonable and practicable. The fairway management will be achieved through river-management practices such as plantings, targeted vegetation spraying and when needed sediment movement (i.e. bank reinstatement and, in extreme cases, channel realignment and cross-blading). Hard options (i.e. gabion cages and rock armouring) will only be used for land stabilisation as a final option; in combination of more 'natural' defences (i.e. piled gravel and plantings) to improve the aesthetics of these management options.

Figure 19 is an example where gravel has been shifted to promote the channel to flow away from the true left bank; it has been eroding between 2004 and 2016. Keeping the fairways to the mapped lines will be undertaken as a pre-emptive process with the aim of limiting the degree of movement/deviation from these areas in flood events. This work will take into account the community values (as discussed in Section 4). Maintenance work undertaken in the Waianakarua River (as discussed above) will be provided for through the budget set in the ORC Annual Plan (Appendix 1). This work will be carried out in collaboration with affected parties.

In some locations, the mapped corridor crosses land that does not currently form part of the active channel of the Waianakarua River, e.g. Figure 17. This is due to the fact that the mapped corridors show an 'envelope' within which the river would migrate under natural conditions. In many instances, they do not reflect the current position of the Waianakarua River. In these situations the ORC will not actively move the fairway into these mapped areas; however, if the channel switches its location into these areas (e.g. in response to a large flood event), ORC may decide not to undertake work to reverse the new alignment if the channel still lies within the mapped corridor.

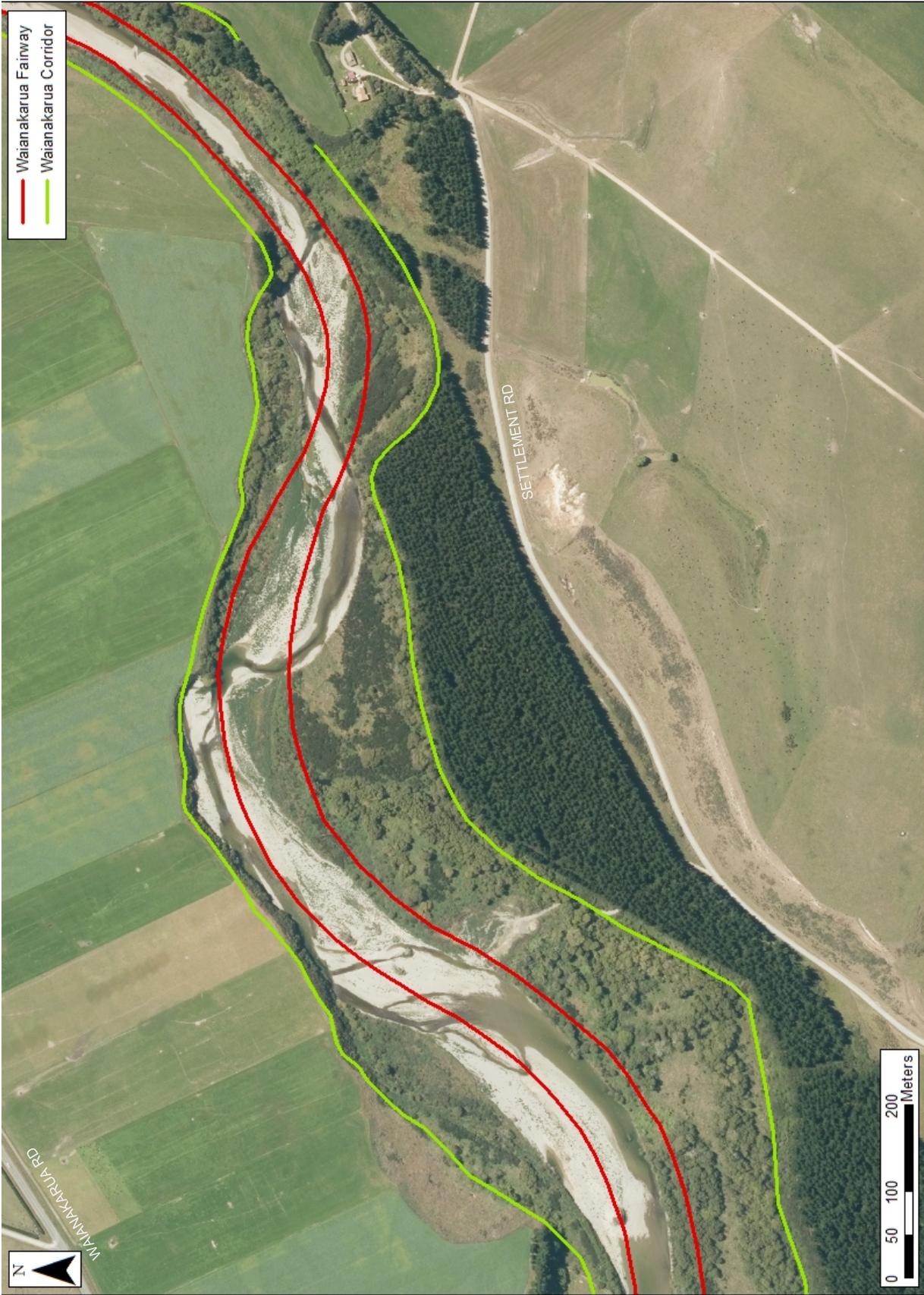


Figure 17. Waianakarua River mapped fairway deviating from the current channel alignment (aerial photography collected in 2016).

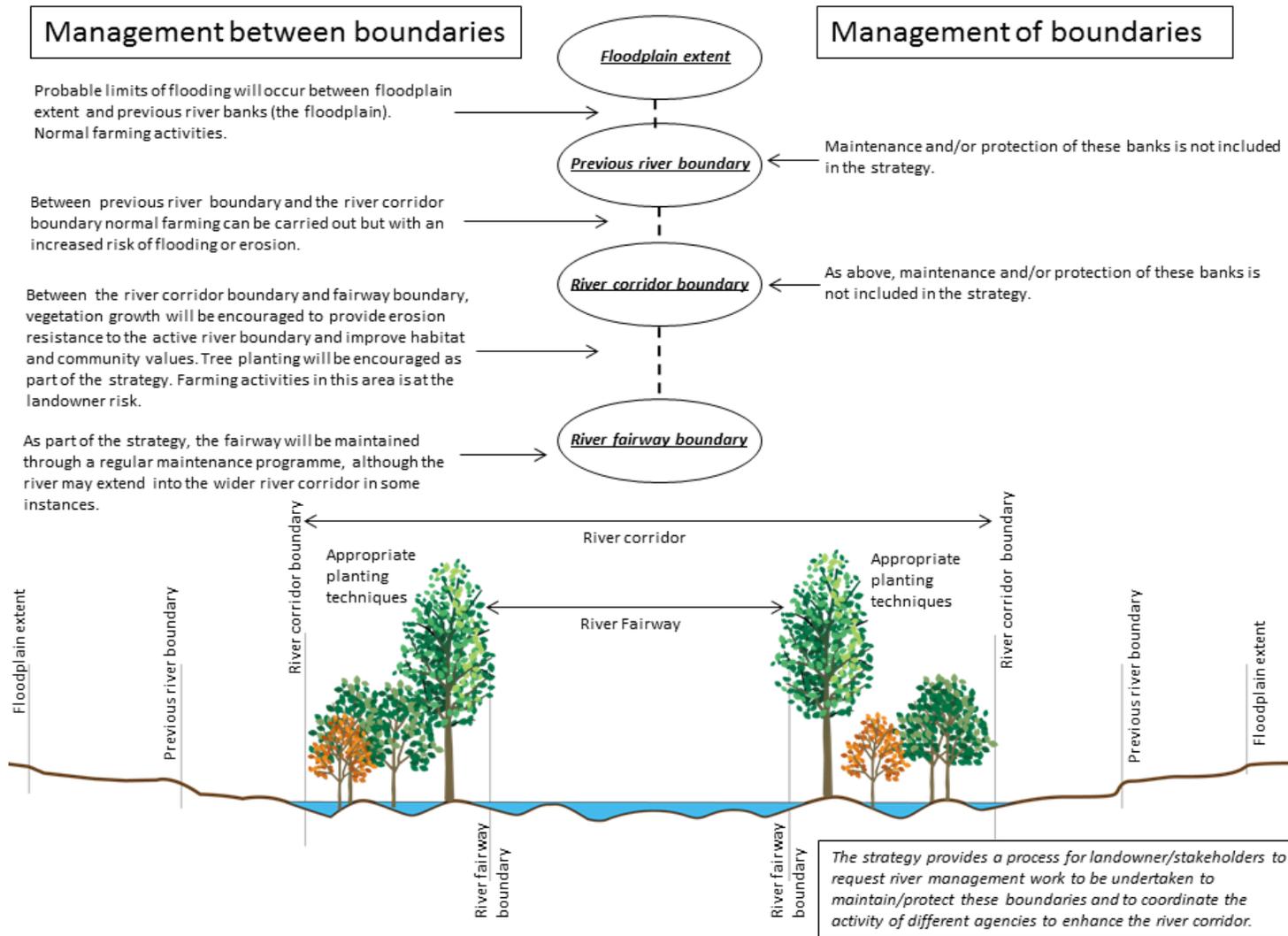


Figure 18. Policy diagram for management of river boundaries and appropriate land-use on floodplain areas of the Waianakarua River.

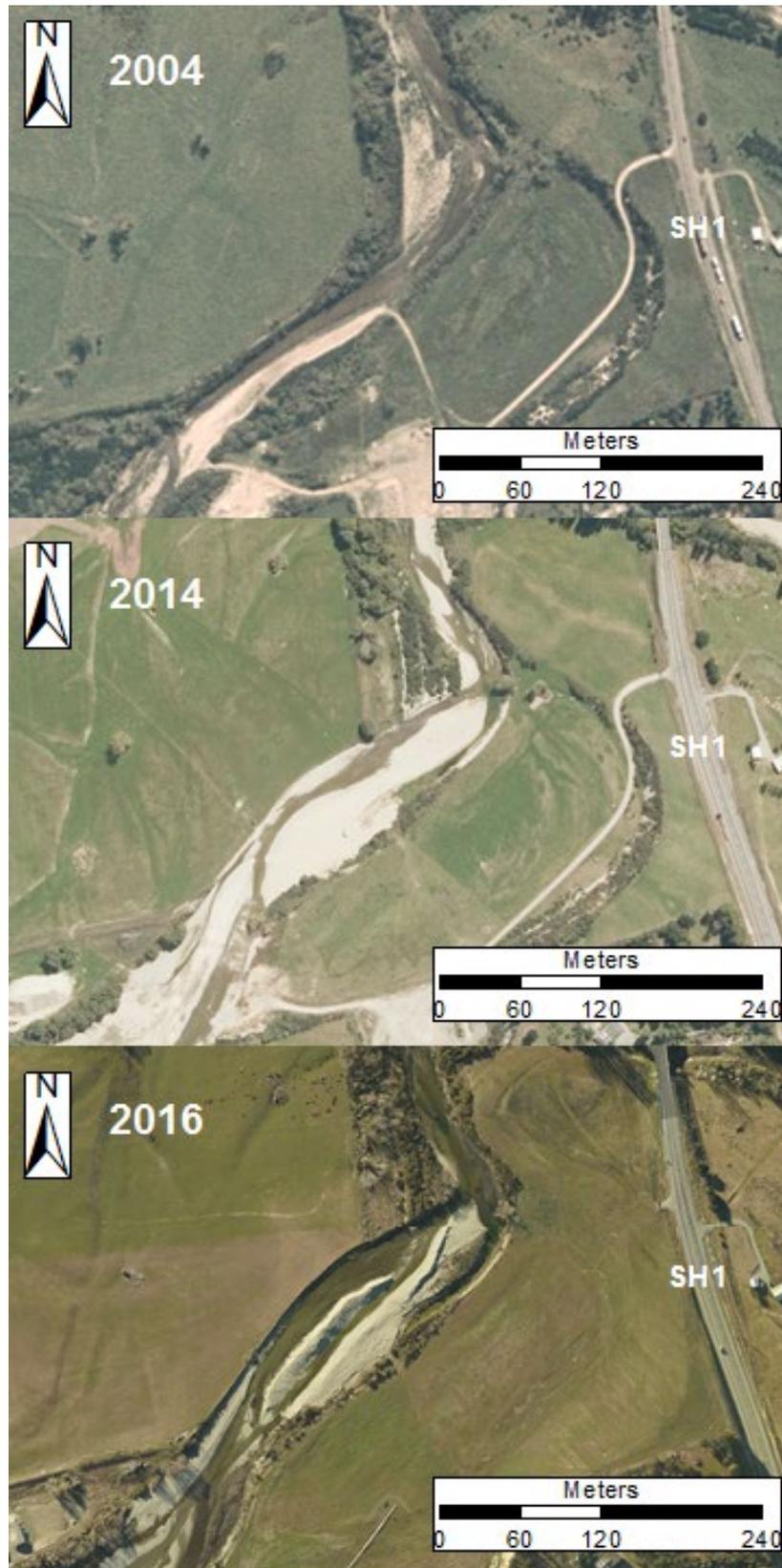


Figure 19. Aerial photos showing the South Branch of the Waianakarua River between 2004 and 2016, upstream of the SH1 bridge. Erosion of the true left bank within this reach has resulted from lateral changes in the position of the channel. River management work by the ORC in late 2016 has shifted gravel along the banks of the channel, to direct flow away from the true left bank.

8.2. Riparian plantings

As identified in Section 3.7 careful management of riparian margins is key to achieving positive river management outcomes. In addition, feedback from consultation continues to show that iwi, the community and stakeholders would like to see additional planting and management of riparian plantings included in the strategy, as a means of improving the amenity and habitat values of the Waianakarua River, and to help to reduce the effects of erosion (Section 4.2). The principles identified in Section 6 reflect the importance of sustainable river management and enhancing the natural environment.

Research (Slui, 1991; Phillips & Daly, 2008) shows that to achieve bank protection, the Waianakarua River riparian margins¹¹ should be planted in vegetation that assists with bank stabilisation. Planting these buffer areas would provide the banks of the rivers with greater stability and assist with limiting bank erosion, as well as providing vegetative cover to slow flood flows and limit the amount of sediment deposited out of the main channel, while also providing habitat for aquatic life. The wider the area of buffer zone planting, the more effective this will be.

Willow species (particularly moutere and kemuti willow) are more suitable for planting close to the river margin due to their rapid growth, ease of propagation and usefulness for vegetative groynes or bank-lining layering. Other vegetation can also be used, including poplars and alders on the relatively higher/drier land. Certain species of exotics are invasive and spread easily within these environments (i.e. crack willow and certain species of alders). Careful selection should be made of exotic species, to accommodate other community values along the river. Native vegetation can be used further back from the active river margin and can be useful, especially when part of other/wider riparian planting.

Development of the buffer areas can be undertaken as a staged approach, with planting of the active river margin occurring in areas where there is bank exposure, as well as at possible river breakout locations. Planting of the back area can be undertaken where direct river attack (i.e. bank erosion) is less likely to occur and the native species will have time to become established. Buffer development is about establishing a wide and dense vegetated margin that can absorb river attack and provide habitat for aquatic life.

Planting of the banks of the Waianakarua River is generally seen as a beneficial process in most locations. The success of riparian plantings to accommodate the community values along the river depends on species selection; the exclusion of stock from river margins and the use of appropriate planting techniques. There are several methods to plant the banks of the two rivers, with the best method being dependent on the environment where the planting is to take place (see Appendix 3).

¹¹ i.e. the area that acts as a buffer between the active fairway and land used intensively for farming or other activities

Ngā Rūnanga encourage and support native riparian planting, specifically of Taonga and mahinga kai species, by landowners as an important habitat for mahinga kai. The Ngāi Tahu Claims Settlement Act 1998 lists a number of species with which Kāi Tahu are recognised to have a cultural, spiritual, historic and traditional relationship. However, some species considered to be taonga by Kāi Tahu were not included in this list, and Kāi Tahu do not see this list of species as exhaustive. For reference to Ngāi Tahu claims settlement act Taonga species see Appendix 8.

9. Implementation

The objectives of the strategy are listed at the start of this document (in the overview section). The mechanisms that can be used to achieve or implement these objectives are shown in the following tables. These have been derived using the principles outlined in Section 6. The tables below highlight the actions that should be undertaken to maintain and enhance the values associated with the Waianakarua River, as well as the key parties responsible for undertaking the listed actions.

In some cases, ORC has already undertaken work to help achieve objectives, and this work is described within this document (for example, mapping of natural-river corridors). It is noted that many of the key actions below are voluntary and will rely on interactions between the key stakeholders and the community and iwi to be successful. It is also noted that many of the activities will be ongoing, and progress will depend on funding, not only through the ORC Annual Plan process, but also from other agencies and the wider community.

ORC has prepared the strategy, with input from the local community, to help protect the recreational, cultural, and ecological values of the Waianakarua River riverbed, and to enable long-term sustainable use of the land that borders the river. The objectives and actions listed below are intended to help achieve this by guiding work programmes, decision-making activities for the community, stakeholders, iwi and ORC. It is therefore recommended that people who live, work, or play within the Waianakarua River catchment consider and give effect to the principles, objectives and actions listed in this strategy.

Due to the dynamic nature of the Waianakarua River, parts of this strategy are likely to change as the rivers themselves change; this strategy must therefore be treated as a 'live' document (Section 2.3). This means that some sections and maps in the strategy may change in response to changes in the Waianakarua River (e.g. areas of gravel accumulation may shift).

Objective 1 Recognise and characterise natural-river processes

Activity	How this can be done	Intended outcome	Who will lead it	Timing	Comment
1.1. Collect information about flood and erosion processes					
	Map, describe and report on changes in channel morphology	Improved understanding of natural river processes	ORC	Ongoing	Previous reports describing changes in channel morphology are available
	Identify locations where erosion is occurring	Avoid high-value assets in erosion-prone areas	ORC	Ongoing	
	Make information publicly available, including through the Natural Hazards Database	Improved decision-making around placement of assets and land-use activities	ORC	Ongoing	Information is currently available through the Natural Hazards Database
1.2. Identify the location of river corridors, within which the river will naturally meander					
	Determine the natural meander form of the river, considering the existing channel location, and natural controls and restraints	Improved decision-making around placement of assets and land-use activities	ORC	Complete	Maps included in Appendix 4

Objective 2 Equip the community to live with the effects of changes in river morphology

Activity	How this can be done	Intended outcome	Who will lead it	Timing	Comment
2.1. Asset management and land-use practices (e.g. fences, vegetation clearance, and irrigation structure placement) are undertaken in such a way that reduces the risk associated with natural river processes					
	Land-use practices and other activities have greater regard to natural river processes	A reduction in risk over time	Landowners	Ongoing	ORC to provide guidance and information through field-days and other community programmes
	Consider implementation of land-use controls through the District Plan in areas with greater erosion risk	No net increase in risk over time	WDC	Long-term (5-10 years)	Incorporate into future revisions of WDC District Plan
	Identify mechanisms to modify/protect roading assets that consider natural river processes	Roading infrastructure is resilient	WDC	Ongoing	ORC to provide information as necessary
2.2. Consider all available options to manage the effects of bank erosion, including structural and non-structural options					
	Less intensive use of riparian margins	A reduction in risk over time	Landowners	Ongoing	
	Planting of native and exotic species on riparian margins	Increased stability of riparian margins and riverbanks, improve habitat and community values	Landowners	Ongoing	ORC to provide support, as determined through the ORC Annual Plan process ¹² Central South Island Fish & Game

¹² For further information on planting support available for landowners please see the ORC website www.orc.govt.nz in particular; www.orc.govt.nz/Publications-and-Reports/Farming-and-Land-Management/Riparian-management/ and <http://www.orc.govt.nz/Information-and-Services/Environmental-Enhancement-Fund/> or contact ORC.

					Council to provide support (through technical assistance in identifying critical areas in need of planting or vegetation management to improve bank protection) ¹³ .
	Produce guidelines for undertaking planting appropriate for river control and provision of habitat	Increased stability of riparian margins and riverbanks	ORC	Complete	Guidance included as Appendix 3
	Produce maps showing priority planting locations	Community requirements and natural river processes are considered before planting is undertaken	ORC	Ongoing	
	Proactive river management programme	Bank erosion and other river management issues addressed early	ORC	Ongoing	Maintenance work undertaken as provided for through the budget set in the ORC Annual Plan
	Provide information on the Regional Plan: Water permitted activity rules	The community is enabled to complete activities that manage the effects of bank erosion and other river management issues	ORC	Ongoing	Information on permitted activities to be provided to the community at any opportunity
2.3. Enable works that improve the conveyance of floodwater and 'train' the river within its natural corridor, without compromising features that are of high value to the community					
	Physical works by ORC to address existing river management issues	The Waianakarua River is contained, as far as possible, within the natural river fairway/corridor, and convey small to-medium floods without overtopping	ORC	Ongoing	Locations and detail of work to be undertaken between October 2016 and 2019 included in Appendix 1

¹³ For further information contact the Central South Island Fish and Game Council at csi@fishandgame.co.nz.

	Physical works by landowners and other agencies to address river management issues	The Waianakarua River is contained, as far as possible, within the natural river fairway/corridor, and convey small to-medium floods without overtopping	Landowners	Ongoing	ORC to provide guidance on suitable river-management methods (including resource consent requirements) through field days and other community programmes
	Provide information discussing the importance of community/stakeholder values	Works are undertaken in a manner that does not compromise features that are of high value to the community	ORC and the community	Complete	Values discussed in Section 4, these may be modified or adjusted as part of future reviews of this strategy
	Provide information discussing the importance of Mana Whenua values	Works are undertaken in a manner that does not compromise the values of Mana Whenua	ORC and Mana Whenua	Ongoing	Values discussed in Section 4 and Appendix 8, these may be modified or adjusted as part of future reviews of this strategy or future values reports.

Objective 3 Enable sustainable gravel extraction

Activity	How this can be done	Intended outcome	Who will lead it	Timing	Comment
3.1. Ensure sustainable quantities of gravel are extracted, for river management benefits					
	ORC will carry out site visits; analyse gravel takes and continue morphological studies of the Waianakarua River.	Gravel extraction that does not degrade the channel and results in an improvement in river management outcomes.	ORC	Ongoing	
3.2. Identify areas where gravel extraction may affect community values					
	Provide information discussing the importance of community/stakeholder values	Extraction is undertaken in a manner that does not compromise features of the location that are of high value to the community	ORC and the community	Completed	Values discussed in Section 4. These may be modified or adjusted as part of future reviews of this strategy
	Provide information discussing the importance of Mana Whenua values	Extraction is undertaken in a manner that does not compromise values of Mana Whenua	ORC and Mana Whenua	Ongoing	Values discussed in Section 4 and Appendix 8, these may be modified or adjusted as part of future reviews of this strategy or future values reports.

Objective 4 Promote activities that enhance the natural character and enjoyment of the river

Activity	How this can be done	Intended outcome	Who will lead it	Timing	Comment
4.1. Identify the location and characteristics of features that are of high value to the community					
	Community values obtained through consultation and clearly identified within the strategy	Consideration of community values when making decisions	ORC	Completed	Values discussed in Section 4. These may be modified or adjusted as part of future reviews of this strategy
	Mana Whenua values obtained through consultation and clearly identified within the strategy	Consideration of mana Whenua values when making decisions	ORC	Completed	Values discussed in Section 4 and Appendix 8, these may be modified or adjusted as part of future reviews of this strategy or future values reports.
4.2. Establish riparian plantings that serve a purpose, and are appealing					
	Produce guidelines for undertaking planting appropriate for river control and provision of habitat	Increased stability of riparian margins and riverbanks. Improved aquatic and terrestrial habitat	ORC	Completed. See also 2.2 above	Guidance included as Appendix 3
	Provide information about Mana Whenua positions on riparian planting	Improved aquatic and terrestrial habitat for native mahinga kai and taonga species.	Mana Whenua	Ongoing	Guidance included in Appendix 8.

4.3. Provide access for fishing activities and habitat for fish					
	Planting work that facilitates fishing activities and enhances fish habitat	The Waianakarua River supports a regionally important sports fishery, and important populations of native fish (including threatened and endangered species)	Central South Island and Otago Fish and Game Council, DoC	Ongoing	
	Consent conditions ensure that gravel extraction and physical works are undertaken in a way that does not damage habitat	The Waianakarua River supports a regionally important sports fishery, and important populations of native fish (including threatened and endangered species)	ORC, extractors and landholders	Ongoing	See Objective 3 also
	Encourage the creation of additional public access points	River-access opportunities are increased	ORC, WDC, Central South Island and Otago Fish and Game Council, landowners	Ongoing	
4.4. Adequate pest and weed control activities					
	Landowners (including LINZ) and other stakeholders work collaboratively to manage pest species	The Waianakarua River fairway and riparian margin are relatively free of pest species	Landowners, stakeholders, ORC	Ongoing	

4.5. Discourage dumping, and arrange the regular collection of rubbish					
	Collection of rubbish through regular/routine work at key locations. Signs warning of penalties for rubbish dumping to be erected if issues persist.	Improved visual amenity and enjoyment of recreational areas	WDC	Ongoing	
4.6. Protect and enhance the natural character of the Waianakarua River					
	Promote and encourage local restoration initiatives such as bank planting and wetland restoration	Riparian margins are planted/restored, look visually appealing, and provide aquatic and terrestrial habitat	Community and support from other agencies	Ongoing	

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Appendix 1. ORC river maintenance work within the Waitaki Special Rating District

Four locations (A, B, E, G) within the mapped river corridor have recently had works completed and two locations (C, D, F) have been identified as requiring work to maintain the fairway within its natural position (as mapped in Appendix 4) and/or to ensure the adequate conveyance of floodwater¹⁴. These locations are shown on Figure 20. These priority locations have been determined using the latest information available (April 2017) about specific locations that are experiencing river management issues. ORC intends commencing work at the three proposed locations during the 2017/2018 financial year. Ongoing observations and maintenance may also be required at some of these locations into the future.

This list and the need to undertake work at particular locations may change into the future, in response to flood events and to other river management issues that the community may identify through the process outlined in Section 2.3.

The river management work (outlined below) that is scheduled to take place in the Waianakarua River will need to consider the following:

- The principles outlined in Section 6
- The location and width of the natural river corridor and active fairway as described in Section 7, and other natural river processes as described in the strategy
- The objectives and associated activities listed in Section 7.3. In particular objective 2 (equip the community to live with the effects of changes in river morphology) and activity 2.3 (enable works that improve the conveyance of floodwater and ‘train’ the river within its natural corridor, without compromising features that are of high value to the community)
- The ecological, community and Māori values discussed in Section 4.

The increased program of work in the Waianakarua River and the development of river morphology and riparian management strategies for the Waianakarua and Shag Rivers; increased costs for the Waitaki Special Rating District (SRD) in the 2016/17 year. Revenue from rates within the SRD is projected to increase slightly from \$350,000 in 2016/17 to \$440,000 in 2019/2020, in order to fund additional in-stream work required to meet community river management expectations.

The dynamic nature of these two rivers and the inability to predict the timing or consequences of future flood events in the Waitaki District means there is a risk that this additional funding for river management work may still be insufficient. It is noted that all ratepayers within the Waitaki District contribute funding towards the Waitaki SRD.¹⁵

¹⁴ Note that riparian management / planting work is not described here. As outlined in the overview section, it is intended that subsequent versions of the strategy will include further guidance and plans for undertaking planting on riparian margins, for river management purposes and for habitat enhancement.

¹⁵ The river management rate is currently collected from 12,000 rating units across that part of the Waitaki District

The anticipated budget for river management operations (physical works) in the Waitaki SRD until 2020/21 is shown in Table 5 below. This shows that \$259,000 is budgeted for this work during the 2017/18 year, up \$47,000 from the previous year. As noted above, this budget is not solely for the Waianakarua River and includes other rivers in the Waitaki District, including the Shag, Kauru and Kākanui rivers.

Table 5. ORC river management budget for the Waitaki District

Year	ORC river management (operations) budget
2016/17	\$212,000
2017/18	\$259,000
2018/19	\$324,000
2019/20	\$332,000
2020/21	\$341,000

Planned and Completed River Maintenance Work – Waianakarua River

- A. Work completed at this location involved moving gravel to maintain the active channel fairway (Figure 20).
- B. Work completed at this location involved moving gravel to maintain the active channel fairway (Figure 20).
- C. Work at this location will involve spraying and controlling plants on the river bank and beaches (Figure 20).
- D. The location will be monitored to prevent channel blockages from fallen vegetation. Older willows will be removed from the channel banks and replanted. Spraying will control invasive weed species along the banks of this reach (Figure 20).
- E. Work completed at this location involved moving gravel to maintain the active channel fairway. This location will be monitored for possible gravel maintenance on the beach following significant build up (Figure 20).
- F. Work at this location will involve spraying and controlling plants on the river bank and beaches. Plant clearing will maintain the active channel fairway, to enable clean flow (Figure 20).
- G. Work completed at this location involved spraying and plant clearing to maintain the active channel fairway (Figure 20).

There are many locations along the river fairway where ORC will provide on a case by case basis; trees for planting within the corridor, to help prevent bank erosion and migration of the river from its fairway path.

Figure 20. Locations of completed and proposed operations work along the Waianakarua River.

Appendix 2. Gravel accumulation areas

There are a number of areas within the Waianakarua riverbeds where gravel tends to accumulate. These areas can change position in response to flood events, land use, and sediment inputs. Currently there are multiple areas of natural gravel accumulation, one at the confluence of the north and south branches of the river, another approximately 900 metres downstream of the confluence, on the north branch within Sharps Bend and another on the south branch upstream of Herbert-Hampden road, as mapped in Figure 21. Commercial gravel extraction may be possible in these areas, provided it can be shown to be sustainable, will meet the values and principals outlined in this strategy, and can be managed in such a way as to not have negative effects on the river system.

Areas identified as having community values of high significance which may be negatively affected by gravel extraction, or where extraction will likely have negative effects on riverbed morphology have also been identified (shaded pink in Figure 22).¹⁶ In these areas, large-scale gravel extraction is generally not appropriate, unless there are exceptional circumstances. These reaches include the river mouth and selected areas downstream of the confluence (between the North and South branches); between SH1 and the confluence along both branches and the upper reaches of the strategies area.

Sections of river where small-scale gravel accumulation may occur in localised areas have also been mapped (shaded blue in Figure 22). Gravel may accumulate on smaller pocket beaches (often found on the inside of meander bends) but is generally not available in significant quantities.

When gravel extraction or other river management work is being considered within the river corridor, it should be undertaken with reference to the information provided in this strategy. This includes the mapped fairway and corridor lines (Appendix 4) and the areas mapped in Figure's 21 and 22.

¹⁶ It is noted that other sections of the river (outside those shaded yellow) also have a wide range of important community values which should be considered when assessing proposed gravel extraction activities.



Figure 21. Areas where gravel tends to naturally accumulate in the Waianakarua River.

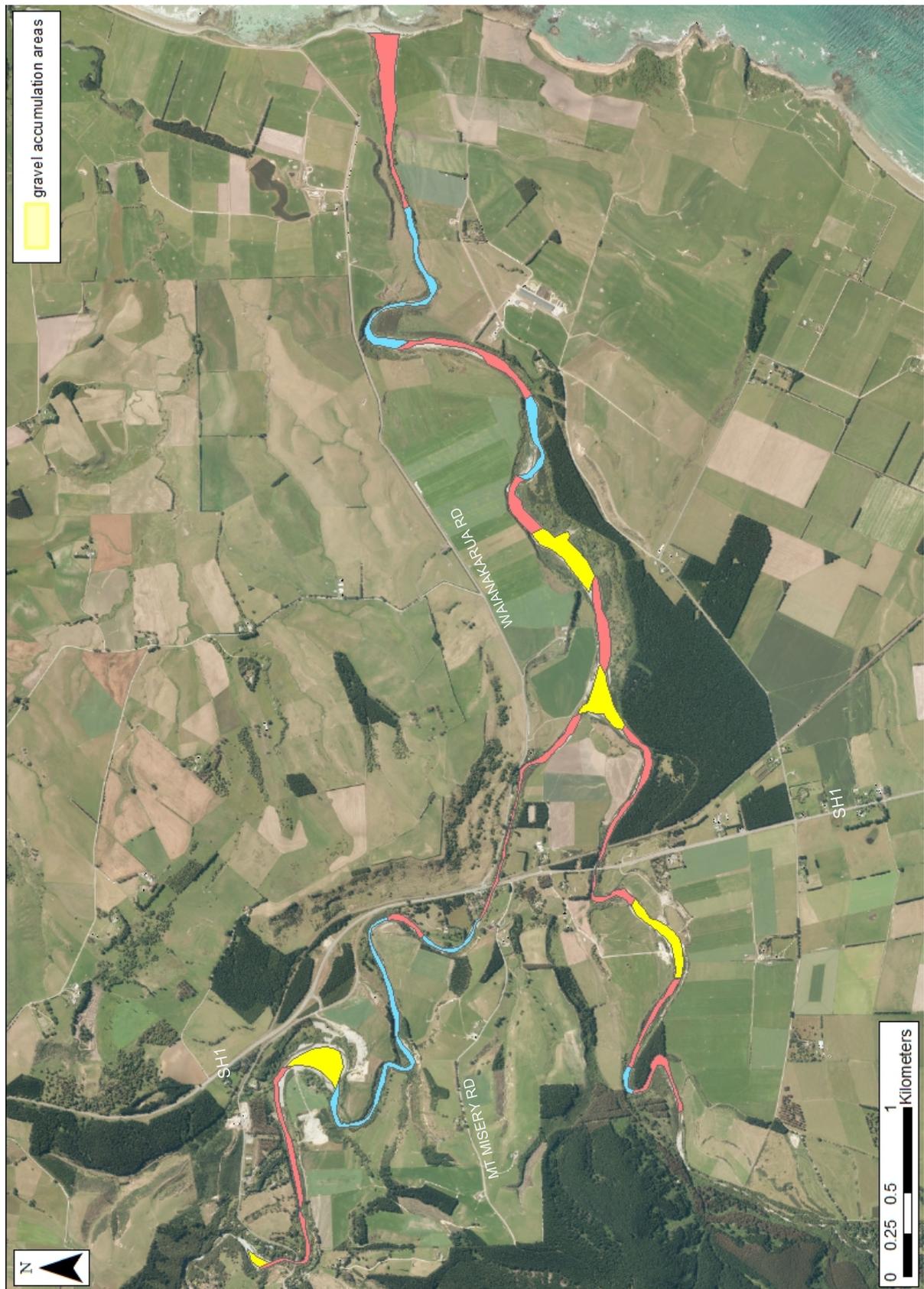


Figure 22. Areas of natural gravel accumulation (yellow); areas where community values could be significantly affected by gravel extraction or where changes in river morphology such as bed degradation and bank erosion are occurring (pink); and areas where small-scale, localised gravel accumulation may occur (blue).

Appendix 3. Planting guide

Benefits of riparian planting¹⁷

The benefits of well-planned and well-managed riparian planting areas on farms are considerable, and include:

- Increasing the quality and health of waterways
- Increasing the ability to filter nutrients before they reach waterways – Nitrogen, Phosphorus, and bacteria/viruses e.g. *E.Coli*
- Reducing sediment runoff and anchoring banks
- Reducing soil erosion of banks in waterways
- Providing shade, which reduces waterway temperatures and shelter for stock
- Minimising stock losses as animals are excluded from riparian strips by fences
- Increasing biodiversity – aquatic life, native plants, birds and insects
- Improving recreational opportunities (e.g. fishing)
- Enhancing and beautifying the river margins.

Both native and exotic species can be suitable for riparian planting. The species to be used will depend upon many factors, including environmental factors (exposure, soils, etc.) but also the width of the riparian strip, the height of plantings that is desired, and personal preference.

Using trees to stabilise stream banks¹⁸

Exotics

The most effective trees for stream bank erosion control are exotic willows and poplars. These are planted as stakes (less than 1 m high) or poles (1.5 – 3 m in height). Avoid invasive spreading species, such as crack willow, weeping willow, silver poplar and all non-sterile tree and shrub willows. Before planting fast-growing trees, consider their longer-term maintenance needs.

Winter is the best time to plant these species before stakes or poles sprout new growth. Plant about a third of the length below ground. On waterlogged ground, you can force them in by hand. On firm ground, you may be able to sharpen poles at one end and drive them in with a rammer or use a post auger. Stakes can be planted by putting them into a hole made

¹⁷ Adapted from KCCP planting guide (2015)

¹⁸ Adapted from ORC (2005)

with a length of reinforcing rod or similar. The most important thing is to make sure stakes and poles are firmly planted.

Guide to planting willow poles

Storage

It is recommended that poles are planted as soon as possible following delivery. Poles can be stored for a few weeks in water, standing up in a water trough or pond/creek. The bottoms of the poles should be kept wet to keep them alive and absorbing water. Poles should be stored away from stock.

Planting

Poles should ideally be planted on the outside of river bends, or sections of river where erosion is occurring. Plant poles in rows with 2 – 3 m spacing between them. Poles need to be planted 300-500 mm deep. Try and plant down to ground water level. Either a crow bar, post-hole borer or tractor forks/digger with a spike can be used to make a hole in the ground that the pole can be dropped into, and then packed firm.

Looking after plantings

Fence planting off from stock to protect plants; plant protectors can also be purchased and can help give protection. It is recommended that poles are watered the day after planting and at least once a week during dry weather until they are established.

To stabilise banks:

- Pair-plant along straight reaches – one tree on one bank, one tree on the opposite bank, five to seven meters apart
- Plant at two to three metre spacing at critical points, such as the outside of the bends where erosion is the greatest
- Avoid planting on the inside of bends – soil builds up rather than erodes here, so trees will trap sediment and force current against the outer bank
- Avoid planting narrow channels where trees might impede floodwaters.

By the time trees are four or five years old, there will be a solid mass of roots along the bank. At 10 to 20 years, trees can be thinned to 10 to 12 metre spacing, but no wider. If you use sleeves on poles to protect the willows and poplars, sheep can be grazed around the trees from the time they are planted.

Natives¹⁹

There are many advantages of utilising native plants. These include:

- Enhancing natural character and landscape values
- Forming a habitat corridor and potentially ecological linkage in the catchment
- Restoration of rare riparian forest (and other habitats)
- Creating/enhancing habitat for native birds and invertebrates (including pollinators)
- Restoration or enhancement of threatened plant habitats
- Do not grow as high or require maintenance (e.g. pruning or thinning)
- Self-regenerating and maintaining.

Planting natives for bank stability will enhance the natural biodiversity of your riparian margin and provide habitat for invertebrates and birds. While exotic tree species are proven to stabilise banks, new research shows that native trees, such as ribbonwood, cabbage tree and pittosporum species, are suitable for bank stabilisation. These species are deep rooting, with a good root spread. Planting native species alongside exotics will help to maintain a mostly native planting on your banks.

Tables 6 through 9 list suitable native vegetation to plant in the Waianakarua catchment, including trees, shrubs, tussock, and rare species. Guidance for the establishment of riparian buffer zones along reaches of the Waianakarua River is provided in Appendix 4 and Section 8.1 and 8.2. Additional technical assistance for identifying critical areas in need of plantings or vegetation management to improve bank protection can be provided by ORC staff or Fish and Game (Central South Island Council).

¹⁹ Information on native planting provided courtesy of DoC

Table 6. Suitable native species for the Waianakarua catchment (trees)

Common name	Scientific name	Mix of plants²⁰
Black mapou/kohuhu	<i>Pittosporum tenuifolium</i>	major
Lemonwood	<i>Pittosporum eugenoides</i>	major
Lowland ribbonwood	<i>Plagianthus regius</i>	major
Narrow-leaved lacebark	<i>Hoheria angustifolia</i>	major
South island kowhai	<i>Sophora microphylla</i>	major
Cabbage tree	<i>Cordyline australis</i>	major
Broadleaf	<i>Griselinia littoralis</i>	moderate
Marbleleaf	<i>Carpodetus serratus</i>	moderate
Manuka	<i>Leptospermum scoparium</i>	moderate
Chatham Island akeake	<i>Olearia traversii</i>	moderate
hybrid olearia	<i>Olearia x dartonii</i>	moderate
Silver beech	<i>Lophozonia (Nothofagus) menziesii</i>	major
Red beech	<i>Fuscospora (Nothofagus) fusca</i>	moderate
Mountain beech	<i>Fuscospora (Nothofagus) cliffortioides</i>	moderate
Kahikatea	<i>Dacrycarpus dacrydioides</i>	minor
Mountain totara	<i>Podocarpus hallii</i>	minor
Matai	<i>Prumnopitys taxifolia</i>	minor

²⁰ The major, moderate or minor is intended to direct the numbers/mix of plants used in a riparian/restoration planting. Therefore the bulk of the plants would compose the 'major' species, with some of the 'moderate' species and only a few of the 'minor' species. The species mix may be in the order of 10 of a 'major' species to 5 of a 'moderate' species to 1 of a 'minor' species.

Table 7. Suitable native species for the Waianakarua catchment (shrubs)

Common name	Scientific name	Mix of shrubs
Mingimingi	<i>Coprosma propinqua</i>	major
A coprosma	<i>Coprosma dumosa/tayloriae</i>	moderate
A coprosma	<i>Coprosma rigida</i>	moderate
Koromiko	<i>Hebe salicifolia</i>	major
Cottonwood	<i>Ozothamnus vauvilliersii</i>	moderate
Weeping mapu	<i>Myrsine divaricata</i>	minor

Table 8. Suitable native species for the Waianakarua catchment (tussock and tussock-like plants)

Common name	Scientific name	Mix of tussock and tussock like plants
Ballerina sedge	<i>Carex secta</i>	major
Toetoe	<i>Austrodieria (Cortadieria) richardii</i>	major
Lowland flax	<i>Phormium tenax</i>	major
Red tussock	<i>Chionochloa rubra ssp. cuprea</i>	moderate

Table 9. Suitable native species for the Waianakarua catchment (rare species)

Common name	Scientific name	Status
Pomahaka tree daisy	<i>Olearia fimbriata</i>	Nationally vulnerable
Hector's tree daisy	<i>Olearia hectorii</i>	Nationally endangered

Linear-leaved tree daisy	<i>Olearia lineata</i>	At risk: declining
Fragrant tree daisy	<i>Olearia fragrantissima</i>	At risk: declining
Bloodwood	<i>Coprosma wallii</i>	At risk: declining
Teucrium	<i>Teucrium parvifolium</i>	At risk: declining

General planting tips

- Natives are preferable for the natural character of our landscapes; however, properly chosen exotics, which should not be a weed risk, can be more functional.
- Consider what environment you're planting in; the values you and others have in the waterway environment and what species are needed to achieve these. Some species achieve bank stabilisation in larger waterways (i.e. willows), however block smaller streams and affect the connectivity of flow. Consider the use of natives instead for small streams/creeks and planting natives alongside exotics in larger waterways.
- Winter is the best time to plant exotics (including willows and poplars), before stakes or poles sprout new growth. Importantly, stakes and poles should be firmly planted, with a third of the length below ground.
- The wider the riparian strip that is created and planted, a wider range of benefits will be achieved.
- Riparian strips can be of variable width dependent upon site factors such as access for machinery, height above the river (and flood levels), topography, and soils. An example being that wet areas or depressions behind a river bank or levee should be included, as sediments and nutrients may leak into the river.
- Habitat strips/wildlife corridors need to be wider than 5 m (ideally at least 8 m) in order to incorporate the equivalent of three rows of plantings.
- Plantings can be either in rows or randomly scattered to give a more natural appearance. The scattering of plants and natural appearance is more important for restoration plantings and Habitat strips/wildlife corridors.

- Closer plant spacing will provide greater mutual shelter, and so achieve faster growth, however will require more plants and therefore greater cost. They may also require some thinning later. This balance needs to be considered.
- When planting natives for bank stabilisation, plant at 1.5 – 3 metres spacing.
- The clear felling of existing vegetation and the creation of bare patches should be avoided when planting. Significant bank erosion can result after the removal of vegetation which previously binded the soil. Such practices should be avoided until the root systems of new plantations have become fully established.
- Riparian margins should provide a wide variance of habitat and function. As a part of a wider matrix of habitats in the landscape, creates overhanging or drooping vegetation and shaded pools.
- Additional advice on your site may be available from ORC, Fish and Game, DoC, local nurseries, websites and publications.

Tips for maintaining riparian margins

- Riparian margins should be maintained proactively, to ensure the best chance of planting success. Weed species are often fast growing and can quickly outcompete riparian plantings. Failure to carry out weed management can inhibit the growth and success of riparian plantings.
- Older tree species need to be maintained to prevent blockages and localised flooding associated with limbs and/or trunks that have fallen into the channel. This includes the removal of rotten limbs and large overhanging limbs which are unsupported.

Appendix 4. River corridor: maps

The river fairway and corridor mapping provides guidance for multi-purpose river management, and for the design and implementation of management measures, protection works and in-channel design. When physical works or activities are being considered within the fairway or on the riparian margin, these should be undertaken with reference to the mapped fairway and buffer zones. The method used to define the river corridor is explained in Section 7.

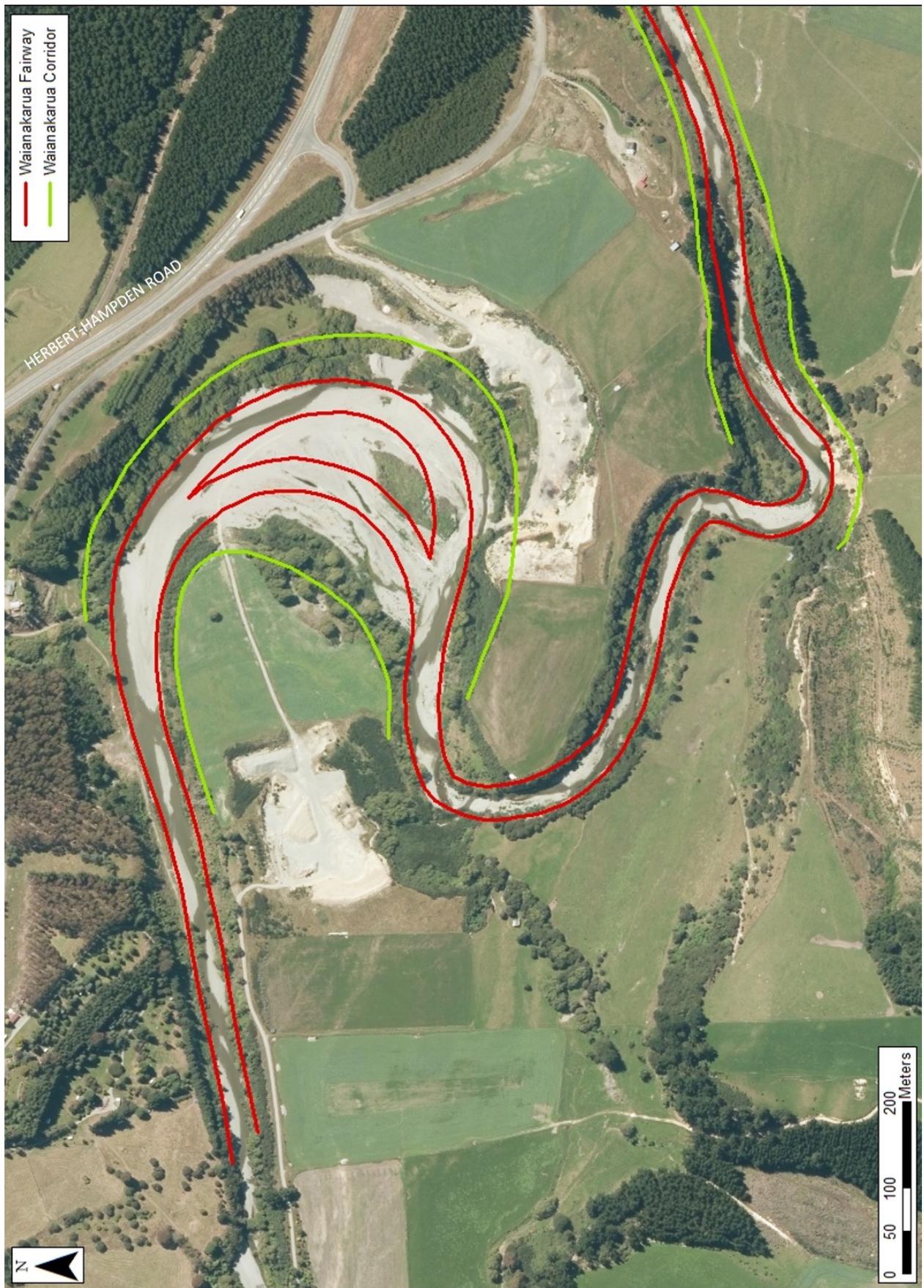


Figure 23. Waianakarua River fairway and corridor Map 1 (aerial photography collected 2014).

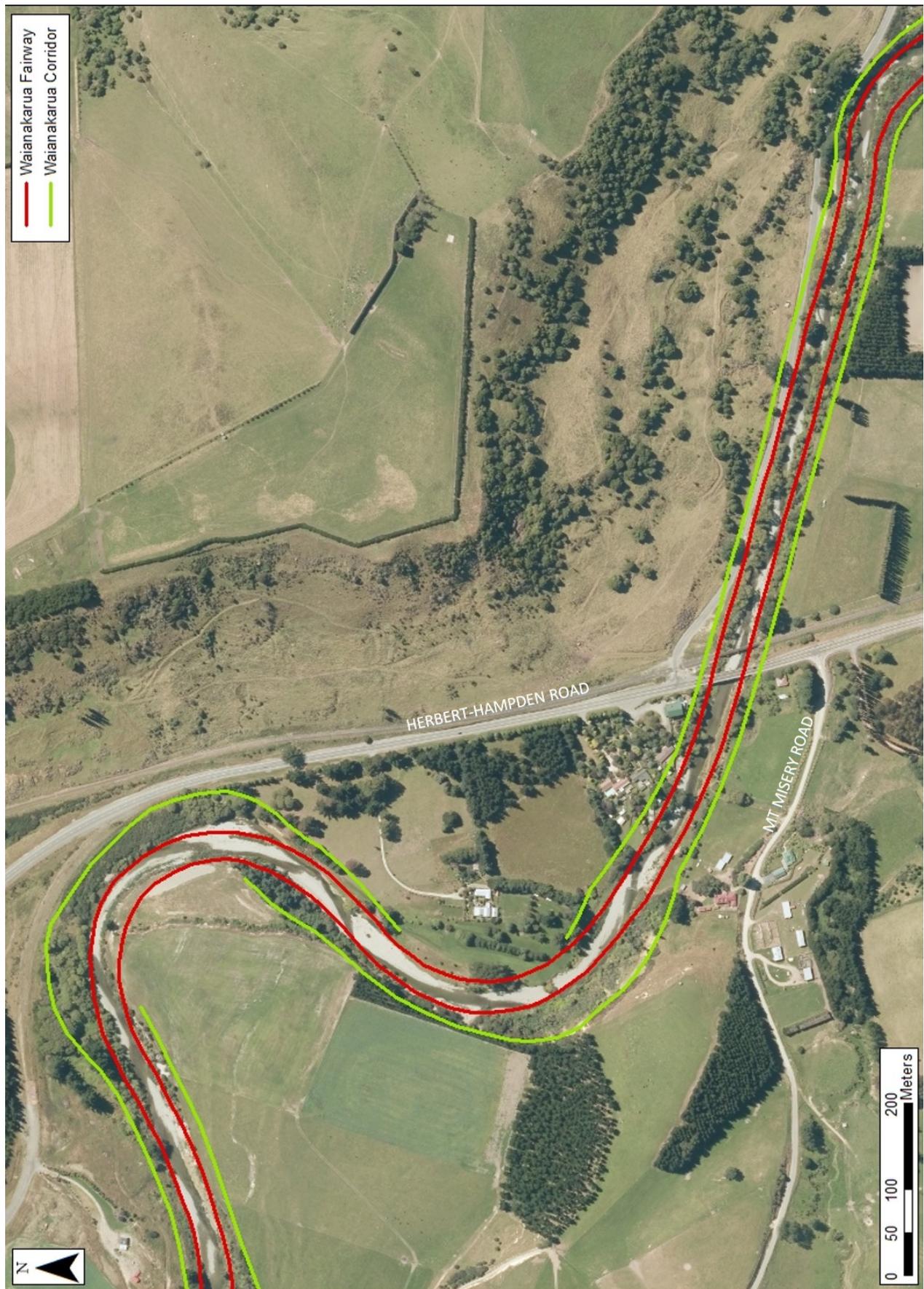


Figure 24. Waianakarua River fairway and corridor Map 2 (aerial photography collected 2014).

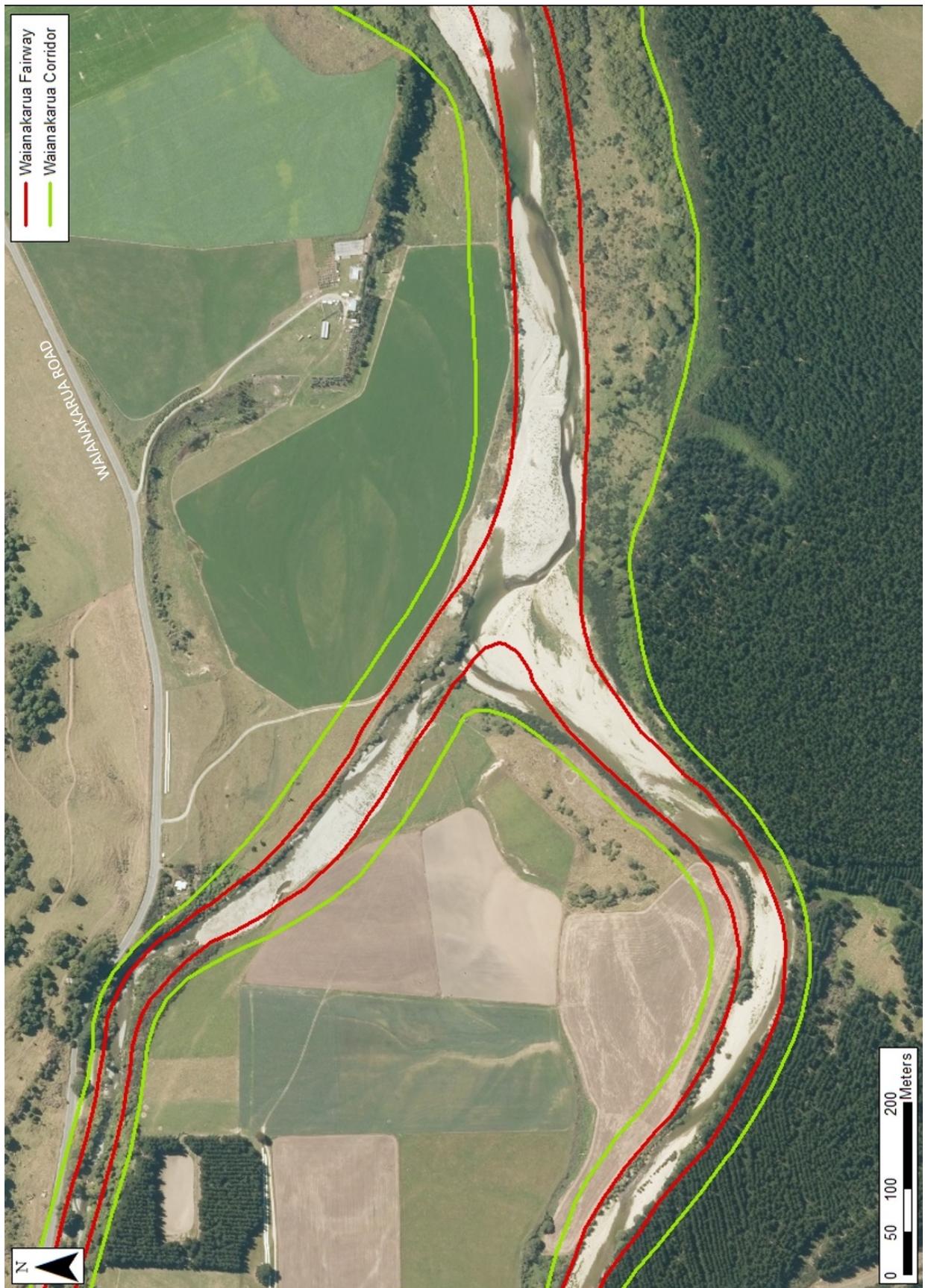


Figure 25. Waianakarua River fairway and corridor Map 3 (aerial photography collected 2014).

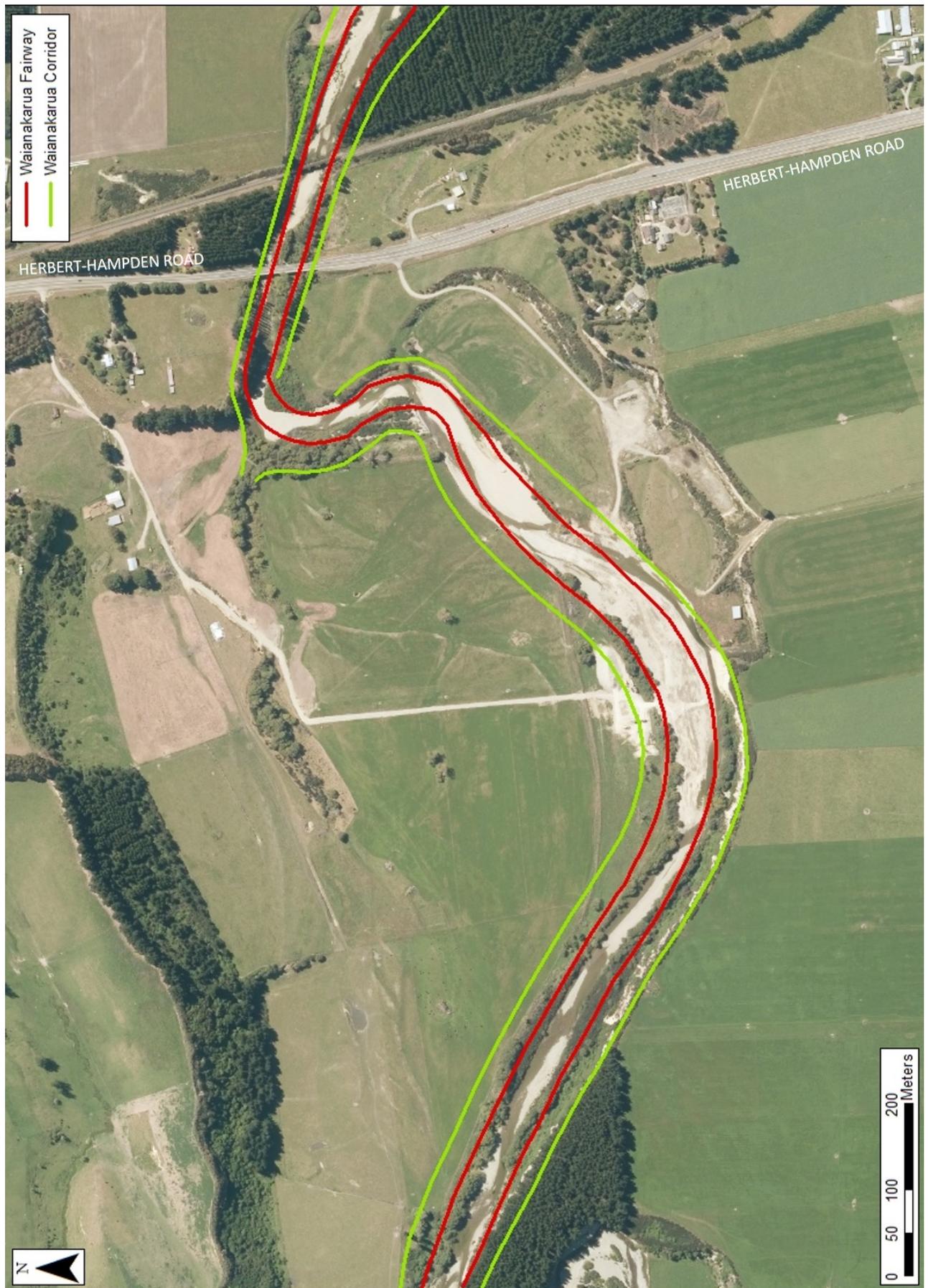


Figure 26. Waianakarua River fairway and corridor Map 4 (aerial photography collected 2014).

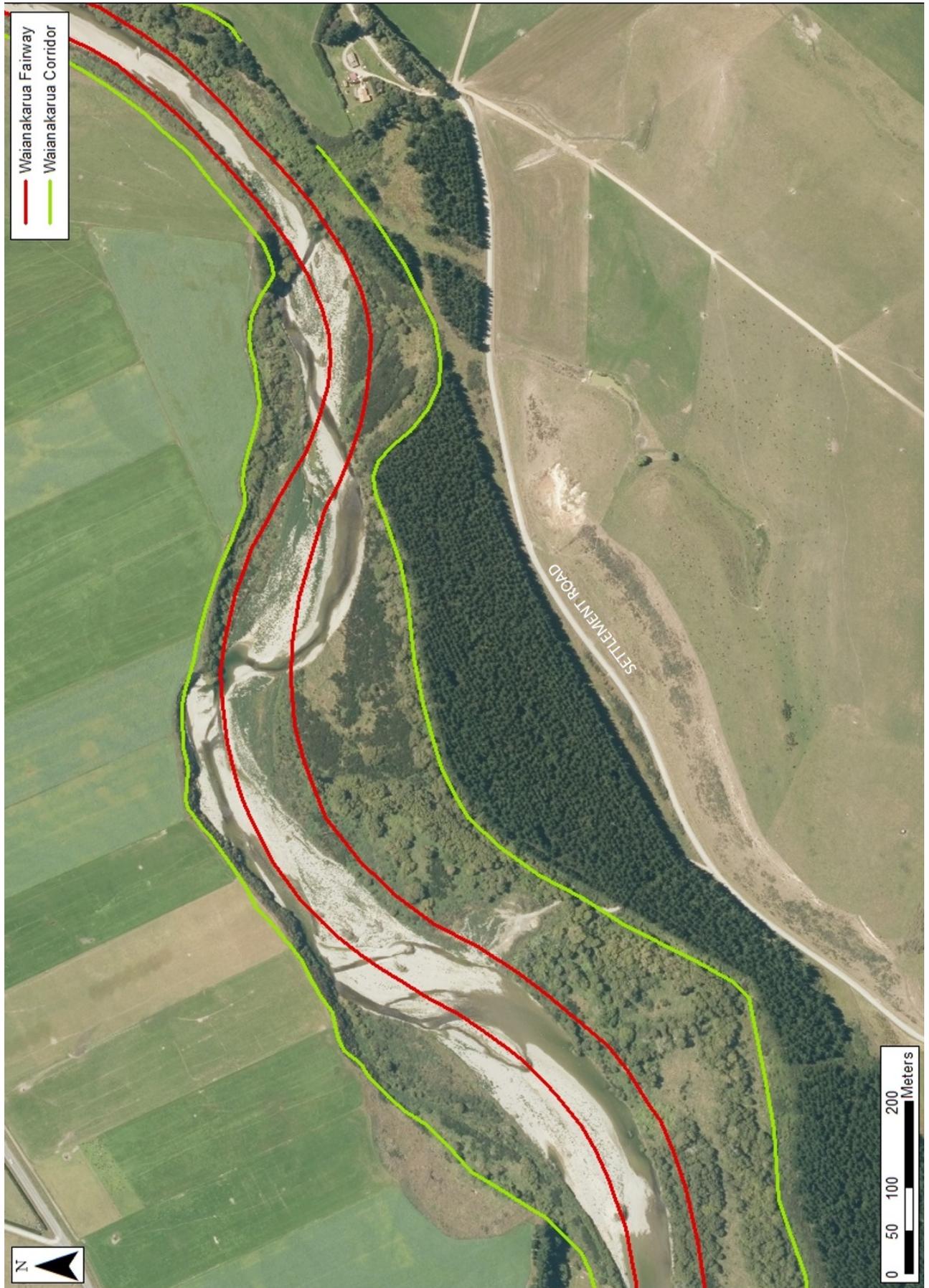


Figure 27. Waianakarua River fairway and corridor Map 5 (aerial photography collected 2014).

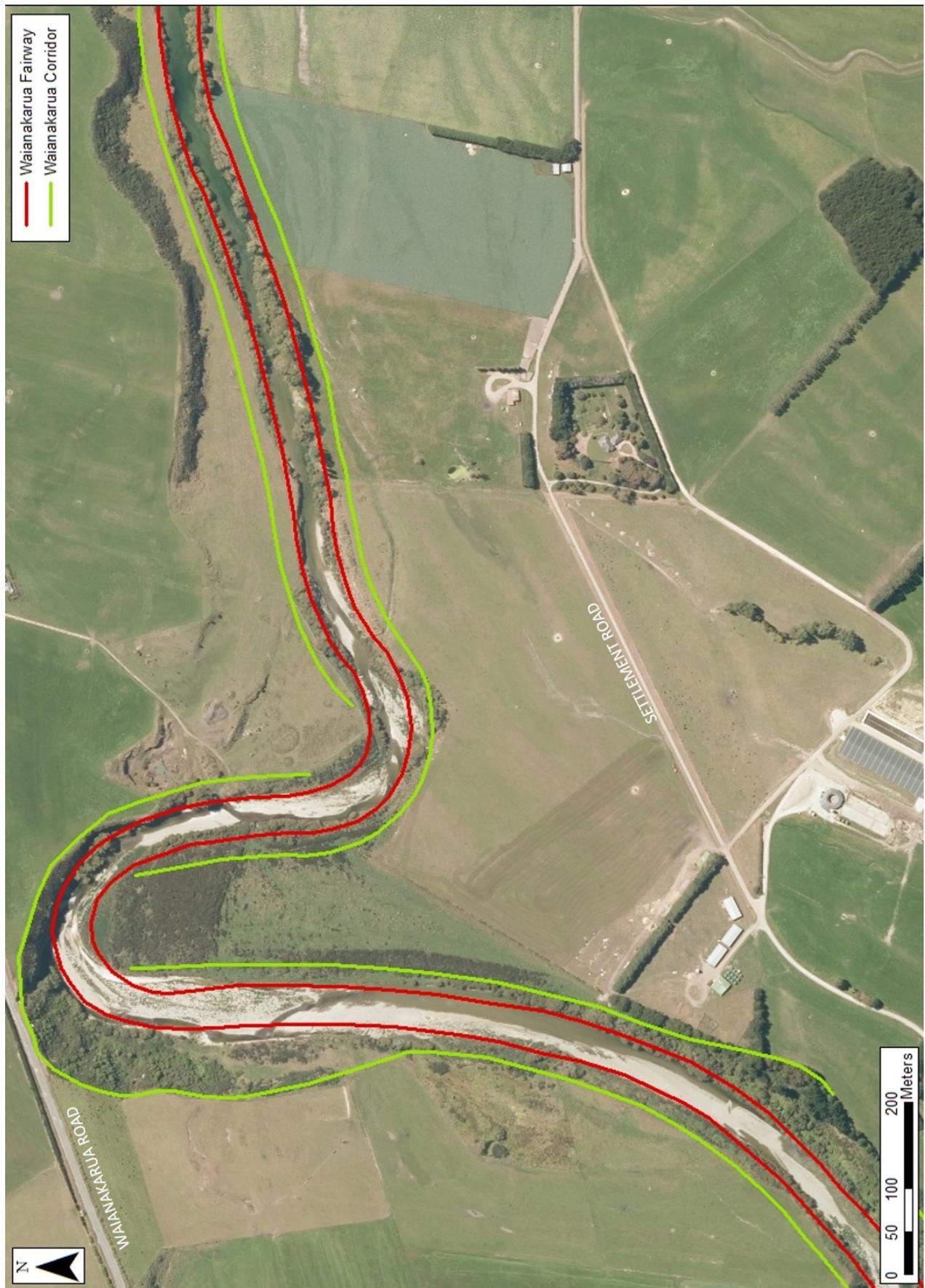


Figure 28. Waianakarua River fairway and corridor Map 6 (aerial photography collected 2014).

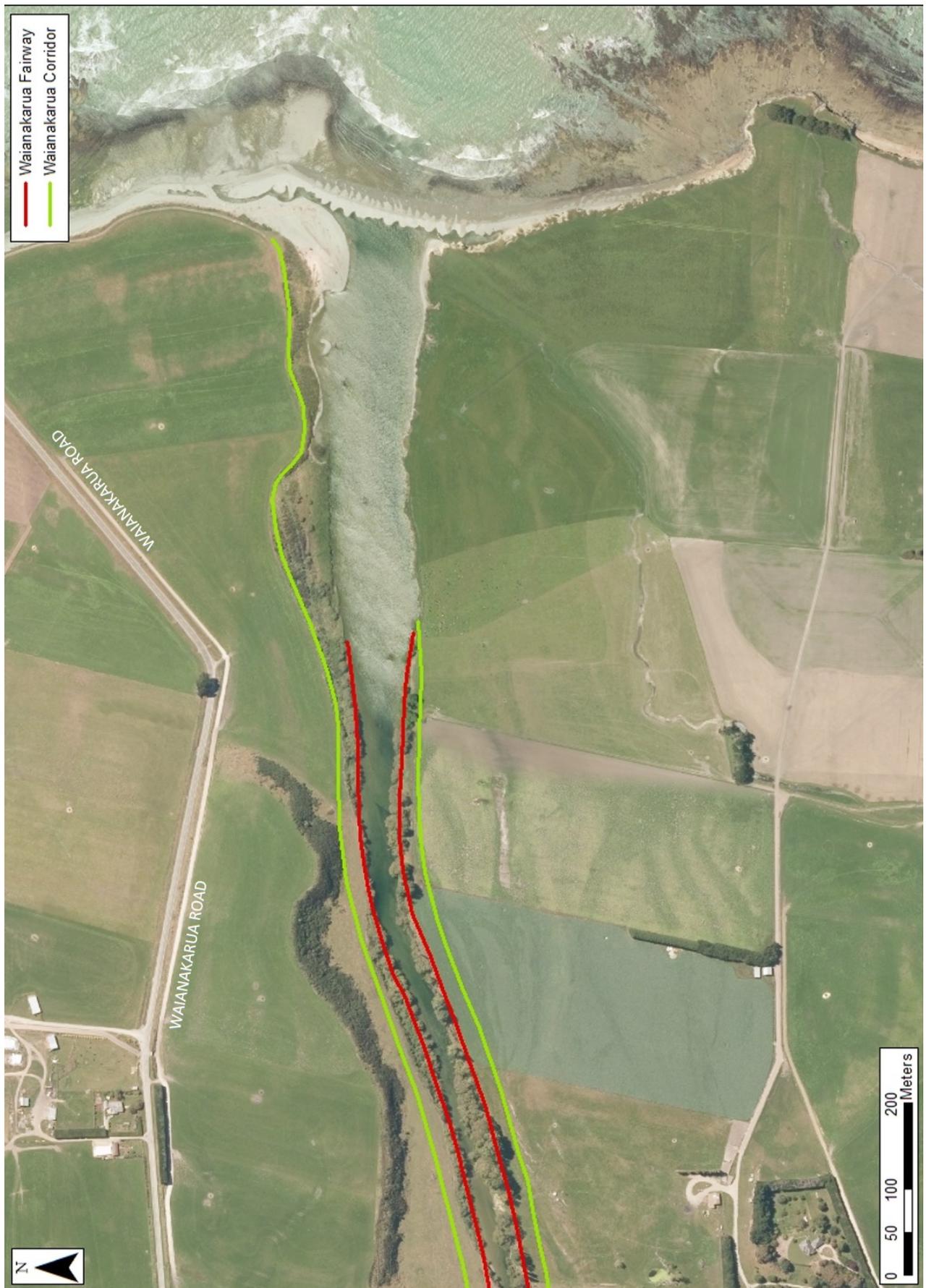


Figure 29. Waianakarua River fairway and corridor Map 7 (aerial photography collected 2014).

Appendix 5. Mapped community values

The maps in this section show the location of important values associated with the riverbed and riparian margins, as identified by the community and other stakeholders. The community consultation process is outlined in Section 4, Appendix 6 provides a summary of public submissions and Appendix 7 provides actual comments and summarised feedback from landowners and stakeholders.

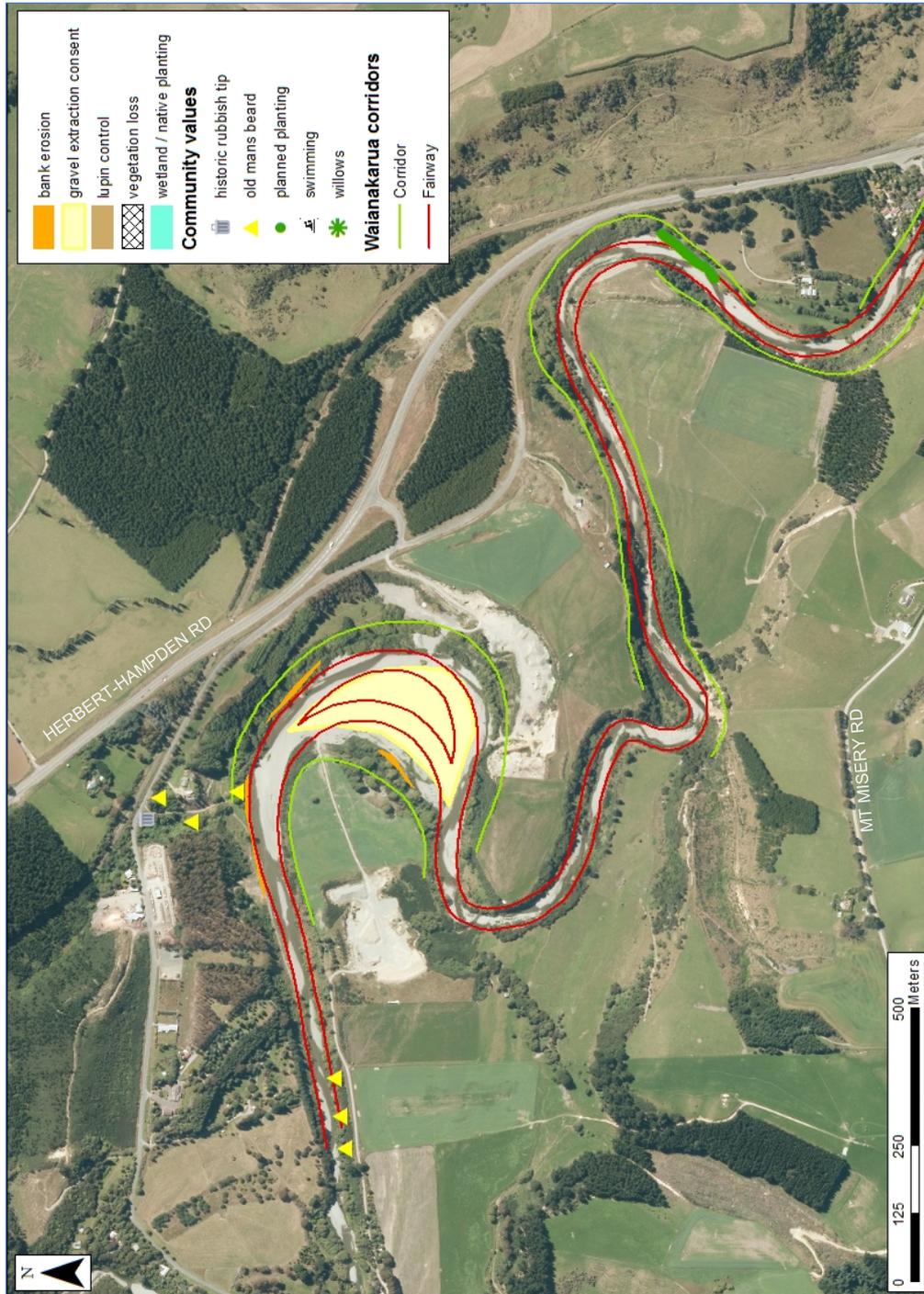


Figure 30. Mapped community values in the Waianakarua River Map 1 (aerial photography collected 2014).

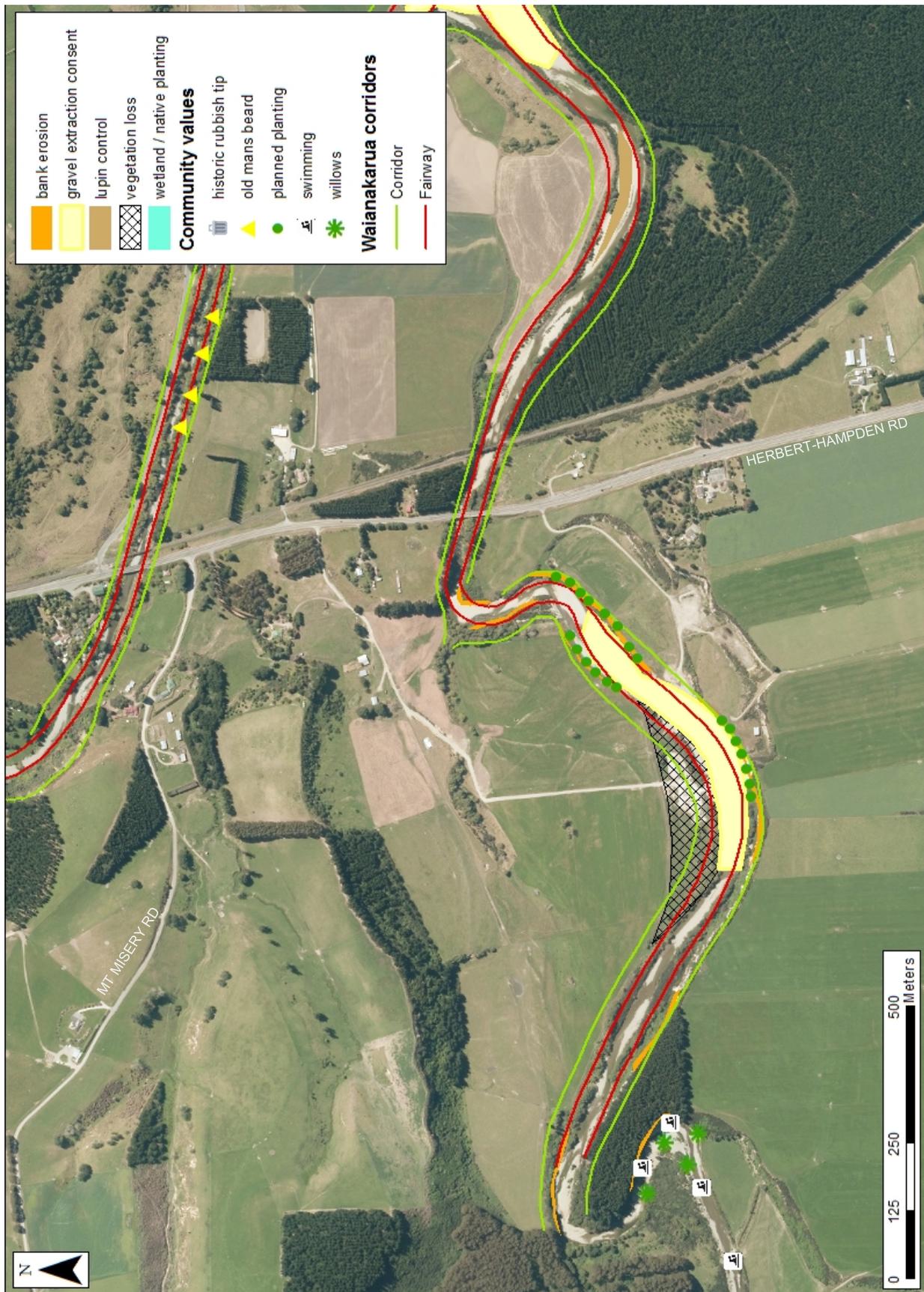


Figure 31. Mapped community values in the Waianakarua River Map 2 (aerial photography collected 2014).

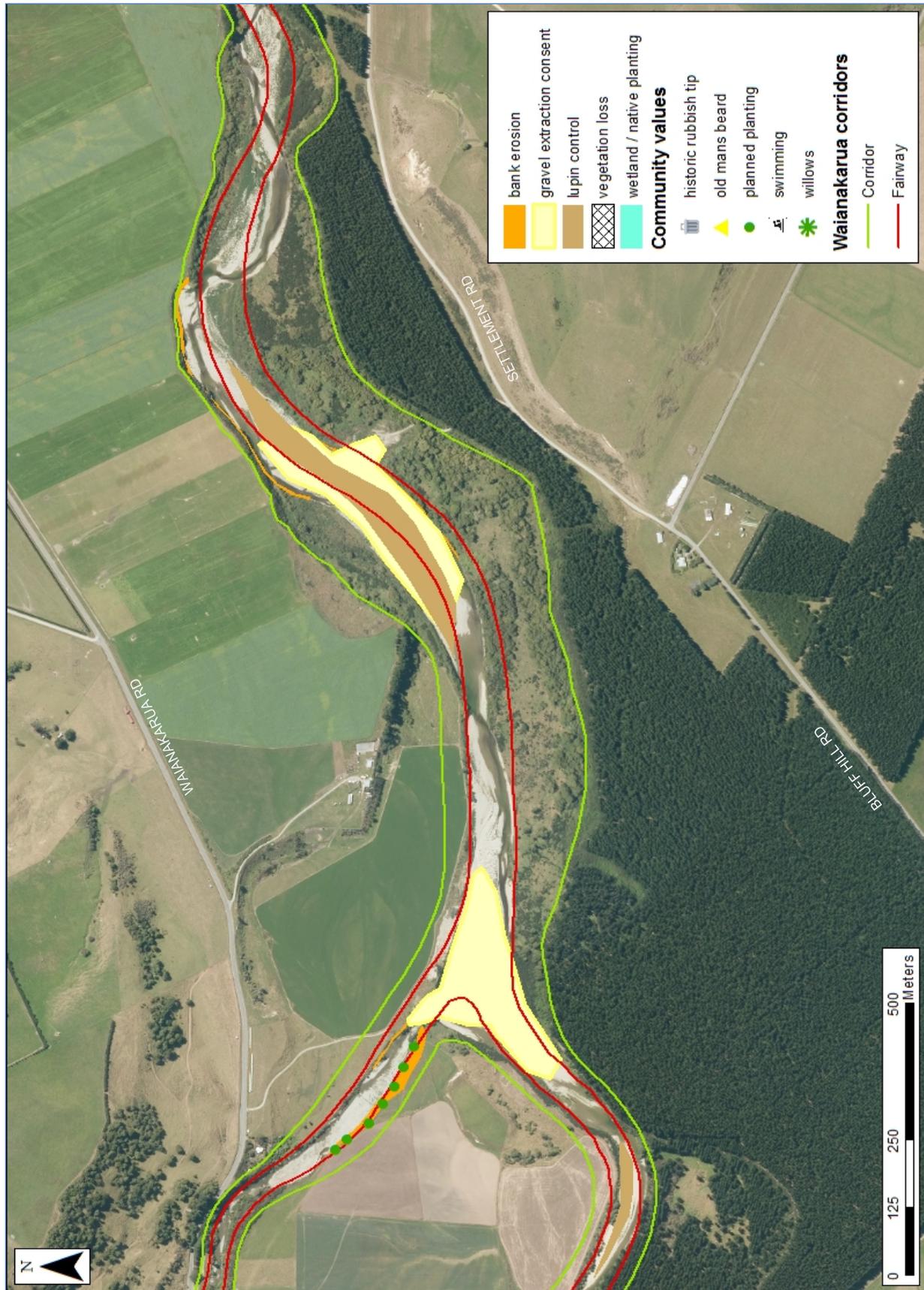


Figure 32. Mapped community values in the Waianakarua River Map 3 (aerial photography collected 2014).

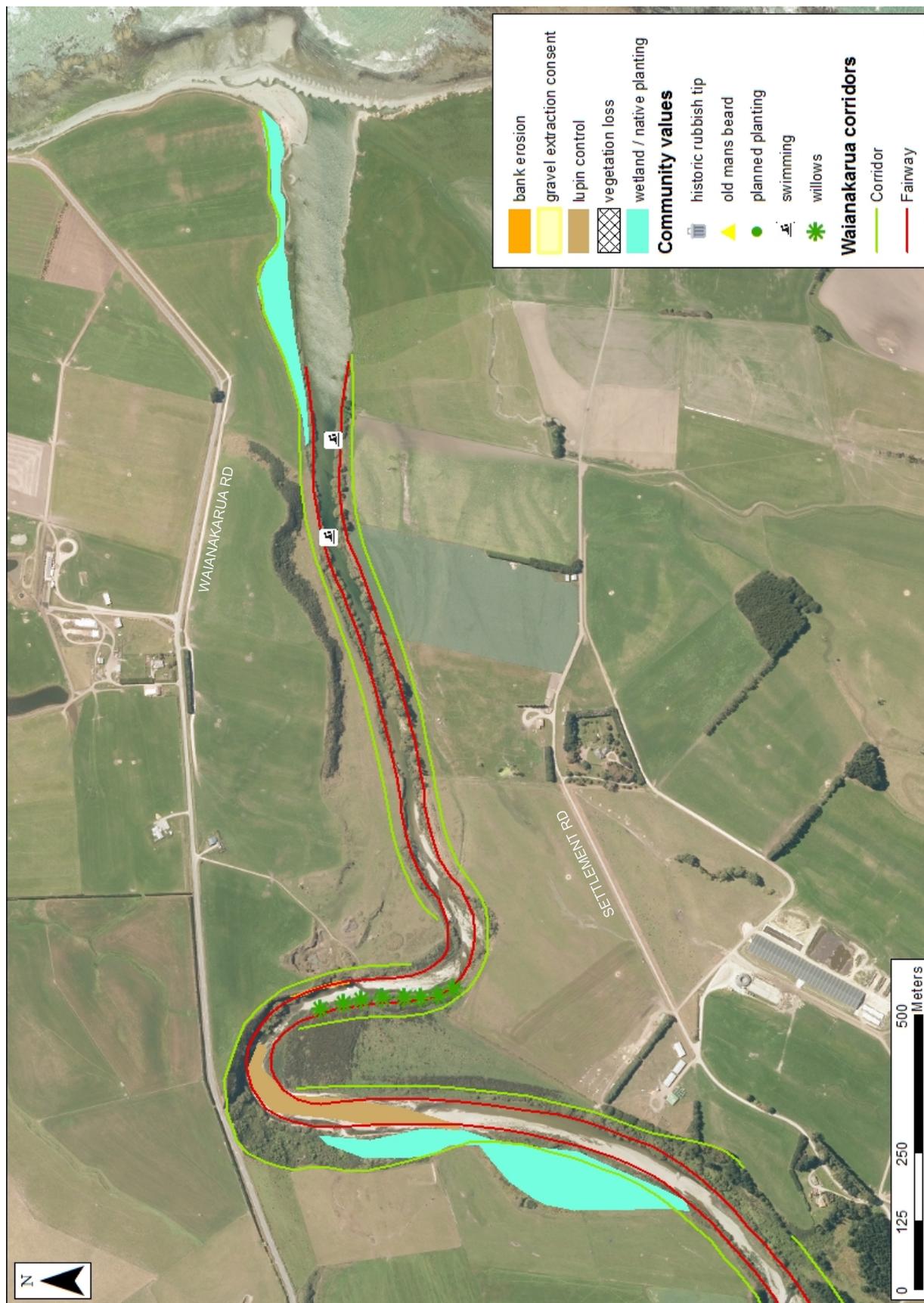


Figure 33. Mapped community values in the Waianakarua River Map 4 (aerial photography collected 2014).

Appendix 6. Community consultations – public submissions

The community consultation in October 2016 included an opportunity for the public to submit on their concerns, as well as a chance to state what they valued about the river and what they would like the strategy to achieve. A diverse range of views and concerns were put forward; some people were concerned about gravel build-up and decline in tree protection, while others were more concerned with the apparent increase in old man's beard, deterioration of supposed Īnanga breeding locations, gravel beach spraying, water quality and leachate from the historic rubbish dump. The river channel should be able to shift laterally within an identified riparian margin. The prevention of erosion to land beyond the river margin and the containment of the main flood flows within the channel, were also highlighted. Residents wanted to be made aware of when weed spraying on the gravel beaches is to occur, this will be taken into account when and as this work progresses. There was some concern that gravel build-up on the true right of the north branch just before confluence has been causing high flows to ruin recently planted trees/protection work. There was further concern that upstream from Sharpe's Bend; sprayed/dead willows have been replaced with old man's beard or similar climbing plants, influencing the aesthetics of the river. Basalt boulder pools around Sharpe's Bend in the north branch of the Waianakarua River were remembered by some locals as a great breeding spot for Īnanga back in the 1980-90s. Residents are worried that a decline in water quality and gravel accumulation in these pools has deteriorated the habitat.

Appendix 7. Community values - feedback from landowners and stakeholder groups

As discussed in Section 4, discussions were held with treaty partners, landowners and stakeholders in 2016-mid 2017. The consultation was framed around two particular topics: i) what concerns they have about the form and function of the Waianakarua River, and ii) how they would like the rivers to look in the future.

This section provides specific comments, and summarised feedback in response to these questions from landowners, DoC, the Waitaki Branch of Forest and Bird and the Central and Otago Fish and Game Councils.

1. The ability of the river to support social, spiritual, recreational and economic values.

- Landowners valued fishing the lower reaches of the Waianakarua River for whitebait and flounder.
- The river is a source of mahika Kai (specifically lamprey, short-fin eel and long-fin eel).
- Locally valued trout fishery.
- Surveys (i.e. the National Angler Survey 2016) show an increased usage of the river since the 2001/02 survey for fishing.

2. River form: riparian plantings, vegetation and fencing

- Want willows to stabilise banks and not result in blockages of the channel which impede flood flows. Can exacerbate flooding in certain reaches due to rapid growth.
- Want to see the benefits of retiring pastoral land for riparian plantings. Concern over using land for riparian plantings. 10-15m is a lot of grazing land lost.
- A preference for native trees rather than exotics such as willows for stabilization purposes.
- Want plantings to be the primary tool for bank stabilisation.
- Concern that willows don't provide the same quality habitat as native plant species.
- If exotic trees are necessary, only sterile and non-invasive species are wanted.
- Want riparian plantings in the lower/mid reaches to provide for whitebait habitats.
- Stock should be excluded from riparian margins to improve the effectiveness of the riparian plantings; protect whitebait habitats; and to reduce the effects on bank stabilisation and water quality.

- In addition to improving the amenity values of the area, riparian plantings can help filter nutrients, act as sediment traps, anchor banks, and provide habitat for both terrestrial and aquatic species.
- Certain riparian species are invasive and costly to manage in the long run; therefore careful selection of species needs to be made.

River form and function: human modification

- Landowners want to ensure that personal gravel takes will be beneficial for the river morphology. Stated that they needed to be able to trust the document.
- Concern that flood issues will just move downstream and that the river will still flood, despite ORC's homework (value careful modification of the river)
- Hard structures should be used as a last resort for land stabilisation and should utilise more natural features (such as piled gravel which is then replanted) to improve the aesthetic look.
- Adequate river flows and appropriate substrate enables spawning success.
- Over extraction of gravel removes potential spawning sites and limits spawning success in a catchment. This has flow on effects on the success of the fishery and recreational opportunities.
- Gravel extraction should only occur in areas of natural accumulation.

4. River form: gravel accumulation

- Want to see surface water flow through areas of high gravel accumulation (where flow can be predominantly through the sub-surface).
- Large gravel beaches have accumulated in the lower reaches of the Waianakarua.

5. River form and function: management education

- Landowners want to know the purpose of willows.
- What is the purpose of controlling weeds on the river banks?
- Ensuring works are appropriately timed, to consider ecological cycles.
- Gravel and substrate plays an important role in ecosystem functions.

Appendix 8 Consultation with Aukaha
Cultural Values Report, Aukaha 2018

Cultural Values Report



Waianakarua Morphology and Riparian Management Strategy

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Introduction

Otago Regional Council (ORC) has asked Aukaha to provide feedback on its draft Waianakarua Morphology and Riparian Management Strategy (the Strategy) on behalf of Mana Whenua.

Aukaha writes this report on behalf of Te Rūnanga o Moeraki, the kaitiaki Rūnanga for the Waianakarua. The purpose of this report is to describe cultural values in the Waianakarua catchment and provide recommendations on how to recognise these values in the Waianakarua Morphology and Riparian Management Strategy.

Mana Whenua Values and Perspectives on Freshwater

Ko te wai te ora ngā mea katoa. Water is the life giver of all things.

Ngāi Tahu see water as a taonga left by the ancestors to provide and sustain life. Water plays a significant role in Ngāi Tahu spiritual beliefs and cultural traditions, the condition of water is seen as a reflection of the health of Papatūānuku. The ability to gather and share food, which is a cornerstone of Ngāi Tahu society, tradition and mana is reliant on healthy ecosystems and especially water that is fit for human consumption and that is able to support mahinga kai species (KTKO, 2005; Tipa and Nelson, 2013).

Ngāi Tahu have a holistic view of environmental management that recognises the intrinsic relationship between the survival of natural resources and the way they are managed and used. Ngāi Tahu have a kaitiaki responsibility to ensure that resources are preserved for future generations – *mō tātou, ā mō kā uri, ā muri ake nei*.

Kaitiakitanga

Kaitiakitanga is the responsibility of Mana Whenua to ensure that the life-supporting capacity (mauri) of the natural resources of their takiwā is sustained. Te Rūnanga o Moeraki are the kaitiaki Rūnanga of the Waianakarua, and are responsible for ensuring that natural resources in the catchment are available for Ngāi Tahu to use now and in the future (KTKO, 2016).

Mahinga kai

Mahinga kai is a cornerstone of Ngāi Tahu cultural identity. Mahinga kai is a term that literally means “food workings” and refers to the places where food is gathered or produced, the traditions and collection methods associated with gathering natural resources for cultural use and the resources themselves. For Ngāi Tahu Whānui today, participation in mahinga kai activities is an important expression of cultural identity. Continuation of traditional practices is an important means of passing values down to children and

grandchildren, ensuring their survival through the generations. This is expressed in the Ngāi Tahu proverbial saying - “Mō tātou, ā mō kā uri i muri ake nei - for us and for the generations that come after us”. Healthy waterbodies continue to be a direct source of mahinga kai. Ensuring the health and wellbeing of freshwater is a prerequisite for ensuring the continued health and wellbeing of mahinga kai resources and ultimately the people (Te Rūnanga o Ngāi Tahu, 2002; KTKO, 2005; KTKO, 2016).

Ki uta ki tai

Mana Whenua believe that a holistic approach should be taken to the management of the natural environment. This world view is articulated in the philosophy of ‘Ki Uta Ki Tai’, which is a holistic, culturally based ‘mountains to the sea’ natural resource management framework.

Mauri

All things, both living and non-living possess a mauri or life force. The primary management principle for Māori is the protection of the mauri of an ecosystem. If the mauri of the natural environment is degraded it no longer has the capacity to support cultural uses and values (KTKO, 2016).

Association with the Waianakarua

The Waianakarua River and estuary are recognised as culturally significant areas. They provide significant habitat for many wading bird species and kōhanga (nurseries) for juvenile fish such as pātiki, īnaka and kanakana.

The catchment forms part of a wider cultural landscape of ara tawhito (seasonal trails) along the East coast where whānau and hapū travelled gathering mahinga kai (KTKO, 2005).

Ngāi Tahu Claims Settlement Act 1998

The Ngāi Tahu Claims Settlement Act included as cultural redress a number of mechanisms to recognise and give practical effect to Ngāi Tahu mana over taonga resources and cultural landscapes. These include Taonga Species and Nohoanga.

Taonga species

The Ngāi Tahu Claims Settlement Act 1998 lists a number of species with which Ngāi Tahu are recognised to have a cultural, spiritual, historic and traditional relationship. The list of Ngāi Tahu Taonga Species is attached as Appendix 1. Ngāi Tahu do not see this list of species as exhaustive (KTKO, 2016).

Nohoanga

Nohoanga provide Ngāi Tahu with an opportunity to experience the landscape as their tīpuna (ancestors) did, and to rekindle the traditional practices of gathering mahinga kai.

The term nohoanga (literally meaning a place to sit) traditionally refers to the seasonal occupation sites which were an integral part of the mobile lifestyle of Ngāi Tahu Whānui as they moved around Te Waipounamu (the South Island) in pursuit of food and other natural resources (Te Rūnanga o Ngāi Tahu, 2017).

This traditional concept has been given contemporary effect as a result of the Settlement of the Ngāi Tahu Claim through the allocation of specific nohoanga sites to support mahinga kai activities.

Under the Ngāi Tahu Claims Settlement Act 1998, nohoanga sites are specific areas of Crown owned land adjacent to lakeshores or riverbanks, which can be used to facilitate the gathering of food and other natural resources by Ngāi Tahu Whānui. They are usually one hectare in size.

Ngāi Tahu Whānui (tribal members) have temporary, but exclusive rights to occupy these sites for up to 210 days a year between the middle of August and the end of April each year.

There is a nohoanga site on the Waianakarua River. The Waianakarua (Glencoe Reserve) nohoanga is located just west of Herbert, approximately 30mins south of Oamaru.



Figure 1: Waianakarua nohoanga site

Culturally significant sites

Ngāi Tahu has identified many culturally significant sites throughout their takiwā. Several of these sites are located within the Waianakarua catchment and the area the Strategy applies to. The locations of these sites is known by Ngāi Tahu and is not shared publicly. Sites throughout the Waianakarua are significant for their mahinga kai values, and several species including eels, lamprey, inaka (whitebait), pānako (a type of fern), and āruhe (fernroot) were gathered.

Other values for the area include kāinga nohoanga (settlements), kāinga mahinga kai (temporary settlements where people stayed seasonally while gathering mahinga kai) and place names that record tribal histories. Some significant sites in the Waianakarua carry the names of ancestors from the Ārai-te-uru waka that capsized off the coastline near Matakaea (Shag Point). After capsizing many of the passengers went on shore to explore the land, but they needed to be back at the waka before daylight. Most did not make it in time and instead transformed into many of the geographical features of Te Waipounamu.

Maori Archaeological Sites

The New Zealand Archaeological Association has recorded several Māori archaeological sites in the lower Waianakarua (see Figure 2 below). These include ovens, middens, rock shelters and sites where artefacts and other signs of occupation have been found.

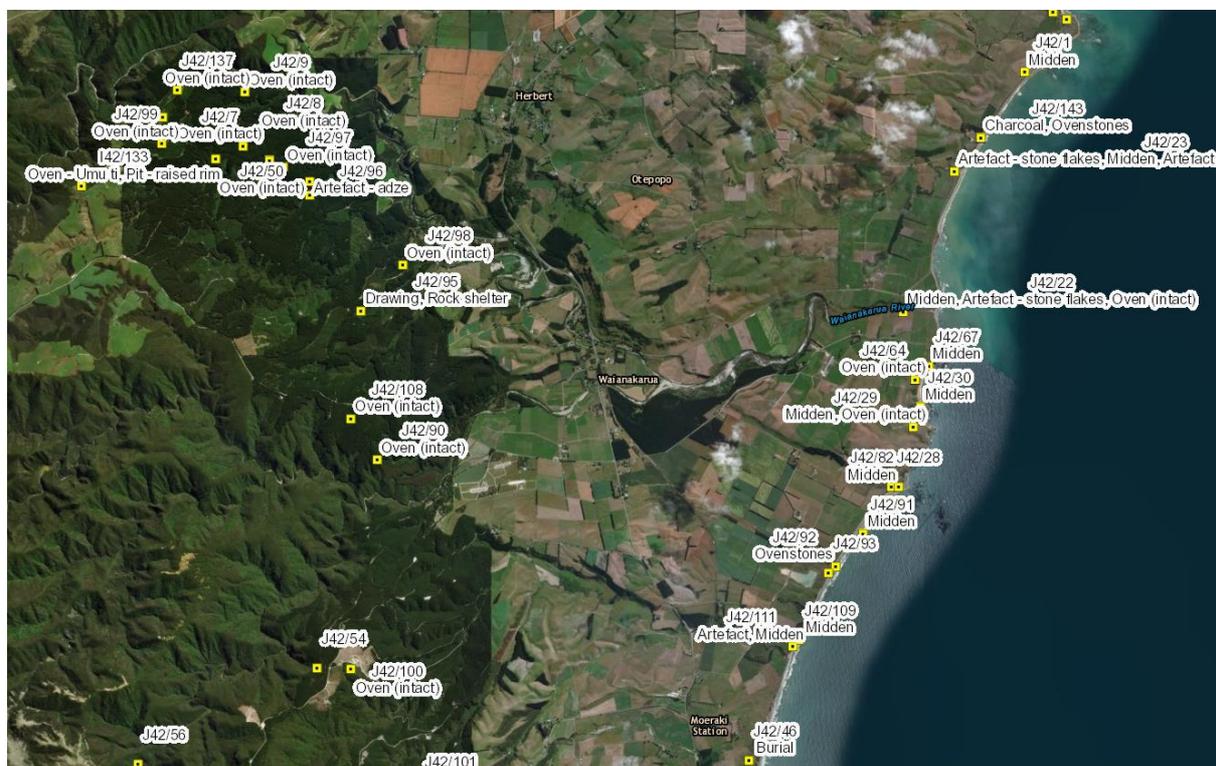


Figure 2: Māori Archaeological Sites within the Waianakarua Catchment

Te Rūnanga o Moeraki aspirations relevant to the Strategy

Te Rūnanga o Moeraki have many aspiration for the rivers across their takiwā. The following Rūnanga aspirations are especially relevant for the Waianakarua catchment and to the Strategy:

- The waters of the Otago Catchment are healthy and support Ngāi Tahu customs
- To protect and restore the mauri of all water
- The rangatiratanga and kaitiakitanga of Ngāi Tahu is recognised and supported
- Ki uta ki tai management of catchments occurs
- Mahinga kai resources are healthy and abundant
- Enhancement of native fish populations and spawning areas
- That fish passage is provided for at all times
- To encourage the planting of native vegetation to help reduce erosion and provide habitat for taonga species

Issues for Te Rūnanga o Moeraki relevant to the Strategy

Te Rūnanga o Moeraki have identified the following issues as relevant to the Waianakarua catchment and the Strategy:

- Negative effects of gravel extractions including alteration of flow and gravel supply downstream, sedimentation, preventing fish passage and affecting freshwater species habitat
- Negative effects on spawning and nursery areas for native fish as a result of sedimentation and grazing (KTKO, 2005)
- Channelisation and channel modification activities are of particular concern to Ngāi Tahu (Te Rūnanga o Ngāi Tahu, 2002a)
- Lack of catchment-wide erosion and riparian management. Although this Strategy does not apply to the whole of the catchment, Te Rūnanga o Moeraki appreciate that it does intend to address issues in a holistic way within the area it applies to.

Recommendations

Te Rūnanga o Moeraki make the following recommendations:

- That a mihi be included at the beginning of the document.
- An introductory section introducing Mana Whenua, explaining who Ngāi Tahu is and who the kaitiaki Rūnanga are is included in the Strategy
- That Mana Whenua are recognised as Treaty partners rather than stakeholders.
- Native riparian vegetation is an important habitat for mahinga kai. This should be included in references to the value and benefits of planting riparian margins.

- That the following positions held by Te Rūnanga o Moeraki are included in this Strategy:
 - Native riparian planting by landowners is encouraged/supported by Te Rūnanga o Moeraki
 - Te Rūnanga o Moeraki prefer that taonga species are used for riparian planting where possible.
 - Where practicable, riparian vegetation should provide habitat for mahinga kai species such as īnanga spawning habitat.
 - Activities in the bed and on the banks of the river should not be undertaken during spawning seasons or during periods when native fisheries are considered sensitive.
 - That any fish disturbed/stranded during any works within any watercourse are rescued and returned/relocated to the watercourse.
 - That fish passage is provided for at all times. Many native freshwater species need to migrate upstream and downstream at different lifecycle stages.
 - That all practical measures are undertaken during works in the bed and on the banks of the river to minimise sedimentation in the waterway and impacts on taonga species and mahinga kai species.

Te Rūnanga o Moeraki and Aukaha staff will continue to work with ORC to incorporate these recommendations into the Waianakarua Morphology and Riparian Management Strategy.

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Appendix 1: Ngāi Tahu Claims Settlement Act Taonga Species

Taonga fish species		
Ingoa Maori	English name	Scientific name
Kāeo	Sea tulip	<i>Pyura pachydermatum</i>
Koeke	Common shrimp	<i>Palaemon affinis</i>
Kōkopu/Hawai	Giant bully	<i>Gobiomorphus gobioides</i>
Kōwaro	Canterbury mudfish	<i>Neochanna burrowsius</i>
Paraki/Ngaiore	Common smelt	<i>Retropinna retropinna</i>
Piripiripōhatu	Torrentfish	<i>Cheimarrichthys fosteri</i>
Taiwharu	Giant kōkopu	<i>Galaxias argenteus</i>

Taonga shellfish species		
Ingoa Maori	English name	Scientific name
Pipi/Kākahi	Pipi	<i>Paphies australe</i>
Tuaki	Cockle	<i>Austrovenus stutchburgi</i>
Tuaki/Hākiari, Kuhakuha/Pūrimu	Surfclam	<i>Dosinia anus, Paphies donacina, Mactra discor, Mactra murchsoni, Spisula aequilateralis, Basina yatei, or Dosinia subrosa</i>
Tuatua	Tuatua	<i>Paphies subtriangulata, Paphies donacina</i>
Waikaka/Pūpū	Mudsnail	<i>Amphibola crenata, Turbo smaragdus, Zedilom spp</i>

Taonga marine mammal species		
Ingoa Maori	English name	Scientific name
Ihupuku	Southern elephant seal	<i>Mirounga leonina</i>
Kekeno	New Zealand fur seals	<i>Arctocephalus forsteri</i>
Paikea	Humpback whales	<i>Megaptera novaeangliae</i>
Parāoa	Sperm whale	<i>Physeter macrocephalus</i>
Rāpoka/Whakahao	New Zealand sea lion/Hooker's sea lion	<i>Phocarctos hookeri</i>
Tohorā	Southern right whale	<i>Balaena australis</i>

Taonga bird species		
Ingoa Maori	English name	Scientific name
Hoiho	Yellow-eyed penguin	<i>Megadyptes antipodes</i>
Kāhu	Australasian harrier	<i>Circus approximans</i>
Kākā	South Island kākā	<i>Nestor meridionalis meridionalis</i>
Kākāpō	Kākāpō	<i>Strigops habroptilus</i>
Kākāriki	New Zealand parakeet	<i>Cyanoramphus</i> spp
Kakaruai	South Island robin	<i>Petroica australis australis</i>
Kakī	Black stilt	<i>Himantopus novaezelandiae</i>
Kāmana	Crested grebe	<i>Podiceps cristatus</i>
Kārearea	New Zealand falcon	<i>Falco novaeseelandiae</i>
Karoro	Black-backed gull	<i>Larus dominicanus</i>
Kea	Kea	<i>Nestor notabilis</i>
Kōau	Black shag, Pied shag, Little shag	<i>Phalacrocorax carbo</i> , <i>Phalacrocorax varius varius</i> , <i>Phalacrocorax melanoleucos brevisrostris</i>
Koekoeā	Long-tailed cuckoo	<i>Eudynamys taitensis</i>
Kōparapara or Korimako	Bellbird	<i>Anthornis melanura melanura</i>
Kororā	Blue penguin	<i>Eudyptula minor</i>
Kōtare	Kingfisher	<i>Halcyon sancta</i>
Kōtuku	White heron	<i>Egretta alba</i>
Kōwhiowhio	Blue duck	<i>Hymenolaimus malacorhynchos</i>
Kūaka	Bar-tailed godwit	<i>Limosa lapponica</i>
Kūkupa/Kererū	New Zealand wood pigeon	<i>Hemiphaga novaeseelandiae</i>
Kuruwhengu/Kuruwhengi	New Zealand shoveller	<i>Anas rhynchos</i>
Mātā	Fernbird	<i>Bowdleria punctata punctata</i> and <i>Bowdleria punctata stewartiana</i> and <i>Bowdleria punctata wilsoni</i> and <i>Bowdleria punctata candata</i>
Matuku moana	Reef heron	<i>Egretta sacra</i>
Miromiro	South Island tomtit	<i>Petroica macrocephala macrocephala</i>
Miromiro	Snares Island tomtit	<i>Petroica macrocephala dannefaerdi</i>
Mohua	Yellowhead	<i>Mohoua ochrocephala</i>
Pākura/Pūkeko	Swamp hen/Pūkeko	<i>Porphyrio porphyrio</i>
Pārera	Grey duck	<i>Anas superciliosa</i>

Pateke	Brown teal	<i>Anas aucklandica</i>
Pīhoihoi	New Zealand pipit	<i>Anthus novaeseelandiae</i>
Pīpīwharau	Shining cuckoo	<i>Chrysococcyx lucidus</i>
Pīwakawaka	South Island fantail	<i>Rhipidura fuliginosa fuliginosa</i>
Poaka	Pied stilt	<i>Himantopus himantopus</i>
Pokotiwaha	Snares crested penguin	<i>Eudyptes robustus</i>
Pūtakitaki	Paradise shelduck	<i>Tadorna variegata</i>
Riroriro	Grey warbler	<i>Gerygone igata</i>
Roroa	Great spotted kiwi	<i>Apteryx haastii</i>
Rowi	Ōkārito brown kiwi	<i>Apteryx mantelli</i>
Ruru koukou	Morepork	<i>Ninox novaeseelandiae</i>
Takahē	Takahē	<i>Porphyrio mantelli</i>
Tara	Terns	<i>Sterna spp</i>
Tawaki	Fiordland crested penguin	<i>Eudyptes pachyrhynchus</i>
Tete	Grey teal	<i>Anas gracilis</i>
Tieke	South Island saddleback	<i>Philesturnus carunculatus carunculatus</i>
Titi	Sooty shearwater/Muttonbird/Hutton's shearwater Common diving petrel South Georgian diving petrel Westland petrel Fairy prion Broad-billed prion White-faced storm petrel Cook's petrel Mottled petrel	<i>Puffinus griseus</i> and <i>Puffinus huttoni</i> and <i>Pelecanoides urinatrix</i> and <i>Pelecanoides georgicus</i> and <i>Procellaria westlandica</i> and <i>Pachyptila turtur</i> and <i>Pachyptila vittata</i> and <i>Pelagodroma marina</i> and <i>Pterodroma cookii</i> and <i>Pterodroma inexpectata</i>
Titipounamu	South Island rifleman	<i>Acanthisitta chloris chloris</i>
Tokoeka	South Island brown kiwi	<i>Apteryx australis</i>
Toroa	Albatrosses and Mollymawks	<i>Diomedea spp</i>
Toutouwai	Stewart Island robin	<i>Petroica australis rakiura</i>
Tūi	Tūi	<i>Prothemadera novaeseelandiae</i>
Tutukiwi	Snares Island snipe	<i>Coenocorypha aucklandica huegeli</i>
Weka	Western weka	<i>Gallirallus australis australis</i>
Weka	Stewart Island weka	<i>Gallirallus australis scotti</i>
Weka	Buff weka	<i>Gallirallus australis hectori</i>

Taonga plant species		
Ingoa Maori	English name	Scientific name
Akatorotoro	White rata	<i>Metrosideros perforata</i>
Aruhe	Fernroot (bracken)	<i>Pteridium aquilinum</i> var <i>esculentum</i>
Harakeke	Flax	<i>Phormium tenax</i>
Horoeka	Lancewood	<i>Pseudopanax crassifolius</i>
Houhi	Mountain ribbonwood	<i>Hoheria lyalli</i> and <i>H. glabata</i>
Kahikatea	Kahikatea/White pine	<i>Dacrycarpus dacrydioides</i>
Kāmahi	Kāmahi	<i>Weinmannia racemosa</i>
Kānuka	Kānuka	<i>Kunzia ericoides</i>
Kāpuka	Broadleaf	<i>Griselinia littoralis</i>
Karaeopirita	Supplejack	<i>Ripogonum scandens</i>
Karaka	New Zealand laurel/Karaka	<i>Corynocarpus laevigata</i>
Karamū	Coprosma	<i>Coprosma robusta</i> , <i>coprosma lucida</i> , <i>coprosma foetidissima</i>
Kātote	Tree fern	<i>Cyathea smithii</i>
Kiekie	Kiekie	<i>Freycinetia baueriana</i> subsp <i>banksii</i>
Kōhia	NZ Passionfruit	<i>Passiflora tetrandra</i>
Korokio	Korokio Wire-netting bush	<i>Corokia cotoneaster</i>
Koromiko/Kōkōmuka	Koromiko	<i>Hebe salicifolia</i>
Kōtukutuku	Tree fuchsia	<i>Fuchsia excorticata</i>
Kōwahi Kōhai	Kōwhai	<i>Sophora microphylla</i>
Mamaku	Tree fern	<i>Cyathea medullaris</i>
Mānia	Sedge	<i>Carex flagellifera</i>
Mānuka Kahikātoa	Tea-tree	<i>Leptospermum scoparium</i>
Māpou	Red matipo	<i>Myrsine australis</i>
Mataī	Mataī/Black pine	<i>Prumnopitys taxifolia</i>
Miro	Miro/Brown pine	<i>Podocarpus ferrugineus</i>
Ngaio	Ngaio	<i>Myoporum laetum</i>
Nīkau	New Zealand palm	<i>Rhopalostylis sapida</i>
Pānako	(Species of fern)	<i>Asplenium obtusatum</i>
Pānako	(Species of fern)	<i>Botrychium australe</i> and <i>B. biforme</i>
Pātōtara	Dwarf mingimingi	<i>Leucopogon fraseri</i>
Pīngao	Pīngao	<i>Desmoschoenus spiralis</i>
Pōkākā	Pōkākā	<i>Elaeocarpus hookerianus</i>
Ponga/Poka	Tree fern	<i>Cyathea dealbata</i>
Rātā	Southern rātā	<i>Metrosideros umbellata</i>
Raupō	Bulrush	<i>Typha angustifolia</i>
Rautāwhiri/Kōhūhū	Black matipo/Māpou	<i>Pittosporum tenuifolium</i>
Rimu	Rimu/Red pine	<i>Dacrydium cypressinum</i>
Rimurapa	Bull kelp	<i>Durvillaea antarctica</i>

Taramea	Speargrass, spaniard	<i>Aciphylla</i> spp
Tarata	Lemonwood	<i>Pittosporum eugenioides</i>
Tawai	Beech	<i>Nothofagus</i> spp
Tētēaweka	Muttonbird scrub	<i>Olearia angustifolia</i>
Tī rākau/Tī Kōuka	Cabbage tree	<i>Cordyline australis</i>
Tikumu	Mountain daisy	<i>Celmisia spectabilis</i> and <i>C. semicordata</i>
Titoki	New Zealand ash	<i>Alectryon excelsus</i>
Toatoa	Mountain Toatoa, Celery pine	<i>Phyllocladus alpinus</i>
Toetoe	Toetoe	<i>Cortaderia richardii</i>
Tōtara	Tōtara	<i>Podocarpus totara</i>
Tutu	Tutu	<i>Coriaria</i> spp
Wharariki	Mountain flax	<i>Phormium cookianum</i>
Whīnau	Hīnau	<i>Elaeocarpus dentatus</i>
Wī	Silver tussock	<i>Poa cita</i>
Wīwī	Rushes	<i>Juncus</i> all indigenous <i>Juncus</i> spp and <i>J. maritimus</i>